BOILERS:

THEIR CONSTRUCTION AND STRENGTH.

A HANDBOOK OF RULES, FORMULÆ, TABLES, &c.,

RELATIVE TO

MATERIAL, SCANTLINGS AND PRESSURES,
SAFETY VALVES, SPRINGS, FITTINGS AND MOUNTINGS,
ETC., ETC.,

FOR THE USE OF

ENGINEERS, SURVEYORS, DRAUGHTSMEN,
BOILER-MAKERS, AND STEAM USERS.

BY

THOMAS W. TRAILL, F.E.R.N.,

MEMBER OF THE INSTITUTION OF CIVIL ENGINEERS,
ENGINEER SURVEYOR-IN-CHIEF TO THE BOARD OF TRADE,
AUTHOR OF "CHAIN CABLES AND CHAINS."

WITH ILLUSTRATIONS.

LONDON:
CHARLES GRIFFIN AND COMPANY.
EXETER STREET, STRAND.
1888.

PREFACE.

A BOOK with the title BOILERS may be expected by some to be one in which the subject is treated more fully than it has been dealt with in the following pages; but there are many reasons *why* the scope of the present work is limited—amongst others, considerations of time and space.

Nevertheless it is hoped that the book will be found of practical service "all round," and helpful, specially, in at least two essential points, viz., in settling the Scantlings for Boilers in process of construction, and in determining the Pressures for those already made. Should the work prove useful in these respects—both of vital importance as regard the safety and efficiency of Boilers—it will have achieved its object.

The Author desires gratefully to acknowledge the able assistance afforded him in the preparation of the Tables by the Computers and Re-computers, who have spared no pains to ensure accuracy in the calculations throughout.

THE CHASE,
CLAPHAM COMMON, S.W.,
December, 1888.

CONTENTS.

INTRODUCTION.

THE Handbook now offered to Engineers and others, while dealing generally with the questions concerned in the Construction and Strength of Boilers, is yet (as stated in the Preface) more especially designed to afford ready and reliable assistance to those who have to settle the SCANTLINGS and determine the suitable WORKING PRESSURES of Boilers.

In regard to the first point, it should be noted at the outset that *thin* plate Scantlings, although included in the Tables, are not given with a view to their being adopted in making *new* Boilers. They are intended to be used, as approximate Scantlings only, by those who have to settle prudent Pressures for *old* Boilers. In such cases, no hard and fast rule can be laid down, and a good deal must be left to the experience and judgment of the Inspector.

The Tables are all original, and have been specially computed for the work. The *form* in which many of them appear is (to the Author's knowledge at least) also new, and their range exceeds that of any set of Tables hitherto published. The arrangement adopted throughout will, it is hoped, be found both simple and convenient. The scope of the work does not admit of giving all the data by which the results have been arrived at, but it is believed that these results will be found to represent the best modern practice according to the method of construction adopted.

As regards the *accuracy* of the Tables, the methods adopted in computation have been of such a nature, that the results may be used with confidence. The calculations throughout have been made by two or three independent computers, and the checking has been done by re-working, and not by merely going over the figures of the first calculation. When differences were observed in the results of any two calculators' work, the computations were re-made.

Those who prefer to calculate results independently, will find numerous simple formulæ given for the purpose throughout the work. There are many, however, who have neither the time nor the inclination to work out formulæ when they can arrive at a decision by a shorter, easier, and more rapid method, and it is for these that the Tables *are chiefly intended. It* may be mentioned that there are about 60,000 *results given in the Tables,* and in order to obtain these results in the

ordinary way, it has been estimated that about six million figures would be necessary. That the use of the Tables, then, will save both time and toil is self-evident. The Notes at the foot of the Tables, and those preceding each Set, will be found of service—examples being given explanatory of the method to be followed.

Among the Illustrations will be found a pair of Spring Safety Valves, and in the corresponding Tables of Dimensions the sizes of the various parts for different pressures are given. These Tables will, therefore, be of value to draughtsmen and others in preparing drawings.

In conclusion, the Author has to point out, that although the results arrived at, both by the Tables and the Formulæ given, may be used without hesitation—yet that it is often advisable, on grounds applicable to the special case, to adopt a more cautious course—*i.e.*, to settle the Scantlings for slightly *higher* pressures than those actually required, or determine the Pressures for boilers already constructed at a few pounds *lower* than the amount arrived at by the Tables. In the interest of the boiler-owner, it will frequently be found a wise economy, "in the long run," to keep the Scantlings rather above, and the Pressures slightly below, the Standards fixed by the Tables. These Standards are, as stated above, *safe;* but it is not always true economy on the part of those who have to pay for repairs and renewals, to adopt the lightest Scantlings and the highest Pressures that *safety* will admit of.

In this, as in other cases, a little "generosity" in the use of material —if one may be allowed to use the phrase—will "pay" best in the end, by ensuring to the boiler a longer and more efficient working-life.

BOILERS:

THEIR CONSTRUCTION AND STRENGTH.

MATERIAL FOR BOILERS.

DEFINITION OF TERMS.

In the following section, some of the properties of Iron and Steel, as employed in the construction of boilers, are given. It is, therefore, desirable that the meanings applied to the various terms used should be clearly understood at the outset. These terms and the meanings assigned to them may, or may not, be precisely those given by other writers, for there is no universal concord of opinion on the subject—a matter much to be regretted. These variations in terminology may have arisen from a desire to avoid the use of any term or any definition which was not accurate in a "commercial" as well as a "scientific" sense; for there can be no doubt that certain terms and definitions, although perfectly correct from a scientific standpoint, may be of little or no value to the practical engineer. However this may be, it is not intended to enter here into the merits or the demerits of terms and their meanings. All that can be attempted now is to give such definitions as shall prevent any possible confusion in the mind of the reader, and make the author's own meaning clear, when dealing with the materials used in the construction of boilers. The definitions necessary for our present purpose are, then, briefly as follows:—

Tensile strength is equivalent to the amount of force which, steadily and slowly applied in a line with the axis of the test-piece, just overcomes the cohesion of the particles, and pulls it into separate parts.

Contraction of area *is the amount by which the area, at the point where the specimen has broken, is reduced below what it was before any strain or pulling force was applied.*

A

Elongation is the amount to which the specimen stretches, between two fixed points, due to a steady and slowly applied force, which pulls and separates it into parts. Elongation is made up of two parts; one due to the general stretch, more or less, over the length; the other, due to contraction of area at about the point of fracture.

Shearing strength is equivalent to the force which, if steadily and slowly applied at right angles or nearly so, to the line of axis of the rivet, causes it to separate into parts, which slide over each other, the planes of the surfaces at the point of separation being at right angles, or nearly so, to the axis of the rivet.

Elastic limit is the point where the addition to the permanent set produced by each equal increment of load or force, steadily and slowly applied, ceases to be fairly uniform, and is suddenly, after this point is reached, increased in amount. It is expressed as a percentage of the tensile strength.

Tough.—The material is said to be "tough," when it can be bent first in one direction, then in the opposite, without fracturing. The greater the angles it bends through (coupled with the number of times it bends), the tougher it is.

Ductile.—The material is "ductile" when it can be extended by a pulling or tensile force, and remains extended after the force is removed. The greater the permanent extension, the more ductile the material.

Elasticity is that quality in a material by which, after being stretched or compressed by force, it apparently regains its original dimensions when the force is removed.

Fatigued is a term applied to the material when it has lost in some degree its power of resistance to fracture, due to the repeated application of forces, more particularly when the forces or strains have varied considerably in amount.

Malleable is a term applied to the material when it can be extended by hammering, rolling, or otherwise, without fracturing, and remains extended. The more it can be extended without being fractured, the more malleable it is.

Weldable is a term applied to the material if it can be united when hot by hammering or pressing together the heated parts. The nearer the properties of the material *after* being welded are to what they were *before* being heated and welded, the more weldable it is.

Cold-short is a name given to the material, when it cannot be worked under the hammer or by rolling, or be bent when cold without cracking at the edges. Such a material may be worked or bent when at a great heat, but not at any temperature which is lower than about that assigned to dull red.

Hot-short is when the material cannot be easily worked under the hammer, or by rolling at a red heat at any temperature which is higher than about that assigned to a red heat, without fracturing or cracking. *Such a material may be* worked or bent at a less heat.

.**ogeneous** describes a material which is all of the same structure ture.

omogeneous material is the best for boilers, and it should be of e **Tensile strength** with **Contraction of area** and **Elongation** ited for the purpose, having an **Elastic limit** that will insure ucture being reliable; it should be **Tough** and **Ductile**, and its **dty** fairly good; and be capable of enduring strains without ng too quickly or easily **Fatigued**. The material should be .**ble** and in some cases **Weldable**; that which is of a decidedly **iort** or **Hot-short** nature should be avoided.

ie physical properties ascertained by the results of tests made he testing-machine, coupled with suitable bending tests, are :tory, and the material is not improperly treated during the s of manipulation, while being put into the boiler, the latter, so :he material is concerned, will generally turn out well, the plates of moderate dimensions.

IRON BOILER PLATES.

Particulars of plates from about three-eighths of an inch to about five-eighths of an inch thick, of six qualities, which were carefully prepared and tested, and such as are used in the construction of boilers, will to some extent illustrate the various qualities of iron plates (within the limits of thickness stated) for boilers, although they may only represent a few of the qualities used.

The "special" quality is very seldom obtained, notwithstanding that it is most suitable for furnaces, combustion boxes, uptakes, and all parts subject to the impact of heat or flame.

"A" quality is such as may be used with confidence for furnaces, and when the plates are exposed to the impact of heat or flame; but even that is a better quality than can be usually obtained.

B, C, D, and E qualities were made by four different makers, and probably represent the best which the respective makers manufacture, as they were made with the view of being equal to a stipulated standard, although they may not all have actually been equal to the standard intended.

B quality need not be considered a low quality for furnaces, &c.; and indeed a much better quality is not easily procured.

C, D, and E qualities are such as are used for shells, although they should *not* be employed if exposed to the impact of heat or flame.

D quality comes within the range of common plates for shells, even when not exposed to the impact of heat or flame.

E quality is a low-class one for any purpose in a boiler.

Special Quality.

Tensile strength, with the grain, ...	23 tons per sq. in.
,, ,, across ,, ...	23 ,, ,,
Contraction of area, with the grain, . .	29 per cent.
,, ,, across ,, .	19 ,,
Elongation, with the grain, ...	19 ,,
,, across ,, ...	13 ,,

A Quality.

Tensile strength, with the grain, . . .	22 tons per sq. in.
,, ,, across ,, . . .	21 ,, ,,
Contraction of area, with the grain, . .	27 per cent.
,, ,, across ,, . .	18 ,,
Elongation, with the grain, ...	18 ,,
,, across ,, ...	12 ,,

B Quality.

Tensile strength, with the grain, ...	22 tons per sq. in.
,, ,, across ,, ...	20 ,, ,,
Contraction of area, with the grain, . .	24 per cent.
,, ,, across ,, . .	12 ,,
Elongation, with the grain, ...	16 ,,
,, across ,, ...	8 ,,

C Quality.

Tensile strength, with the grain, ...	22 tons per sq. in.
,, ,, across ,, ...	21 ,, ,,
Contraction of area, with the grain, . .	14 per cent.
,, ,, across ,, . .	8 ,,
Elongation, with the grain, ...	10 ,,
,, across ,, ...	7 ,,

D Quality.

Tensile strength, with the grain, ...	21 tons per sq. in.
,, ,, across ,, ...	20 ,, ,,
Contraction of area, with the grain, . .	11 per cent.
,, ,, across ,, . .	10 ,,
Elongation, with the grain, ...	8 ,,
,, across ,, ...	7 ,,

E Quality.*

Tensile strength, with the grain, ...	20 tons per sq. in.
,, ,, across ,, ...	19 ,, ,,
Contraction of area, with the grain, . .	9 per cent.
,, ,, across ,, . .	6 ,,
Elongation, with the grain, ...	8 ,,
,, across ,, ...	5 ,,

Notwithstanding the foregoing results, it is difficult to get good makers to guarantee a better quality of plates than the following:—

Tensile strength, with the grain, ...	21 tons per sq. in.
,, ,, across ,, ...	19 ,, ,,
Contraction of area, with the grain, . .	20 per cent.
,, ,, across ,, . .	12 ,,
Elongation, with the grain, ...	16 ,,
,, across ,, ...	10 ,,

The foregoing do not refer to plates above about five-eighths of an inch thick, and include those as thin as about three-eighths of an inch.

The elongation was in all cases taken in a length of 10 inches; the test pieces were 2 inches broad, except in the case of the special quality, in which they were not quite so broad.

The appearance of the fracture of Special, A, and B qualities was

* *There are one or two qualities inferior to E.*

fibrous; that of the others was more or less crystalline. D quality showed about 60 per cent. fibrous and 40 per cent. crystalline. All the plates were made, as previously stated, with the knowledge that they would be tested, which may account for the results obtained.

Iron having the same brand as A quality, has been proved by carefully made tests to be inferior to C quality in tensile strength, contraction of area, and elongation. It is, therefore, not well to rely too much on brands; the only satisfactory plan is to prove the quality by testing. Brands, unfortunately, may be found to be delusory.

It is not probable that the results of any two series of tests will agree in all respects; but when a quality is stipulated for, the results of the tests should closely approximate to the standard agreed upon. Nevertheless, when the difference of the results, length-way and cross-way, is *not very* great as compared with that stipulated for, and the respective means of the results, length-way and cross-way, either as regards the tensile strength, contraction of area, and elongation, are about equal to the respective means of the quality settled upon, the material may be considered as fairly representing that required.

It is better to sacrifice a ton or so in tensile strength, than to lessen the contraction of area and elongation; and, generally, if the two latter be above that stipulated for, even if the tensile strength is rather less, the iron may be considered to be better and more to be relied upon, particularly for flanging.

Thicker plates of a different description, and such as have been more exclusively used for the shells of boilers of considerable size, are dealt with next. The higher qualities only can be accepted as those that can with any degree of propriety be employed for tube-plates, &c., although all the descriptions mentioned have been used for the shells, and even for other parts.

The lower qualities are objectionable, even for shells, and should never be used for tube-plates, or for plates to be flanged or worked. Qualities much better than the highest class specified have not been so generally used as could be desired, and steel plates have almost entirely taken their place. The particulars of these will be given further on.

Three-Quarters of an Inch Thick.

Tensile strength, with the grain, ...	21 tons per sq. in.
,, ,, across ,, ...	19 ,, ,,
Contraction of area, with the grain, . .	18 per cent.
,, ,, across ,, . . .	10 ,,
Elongation, with the grain, ...	14 ,,
,, across ,, ...	8 ,,
Tensile strength, with the grain, ...	21 tons per sq. in.
,, ,, across ,, ...	19 ,, ,,
Contraction of area, with the grain, . . .	9 per cent.
,, ,, across ,, . . .	4 ,,
Elongation, with the grain, ...	7 ,,
,, *across* ,, ...	3 ,,

One Inch Thick.

Tensile strength, with the grain, ...	21 tons per sq. in.
„ „ across „	19 „ „
Contraction of area, with the grain, . .	18 per cent.
„ „ across „ . . .	11 „
Elongation, with the grain, ...	16 „
„ across „	9 „
Tensile strength, with the grain, ...	21 tons per sq. in.
„ „ across „	18 „ „
Contraction of area, with the grain, . .	8 per cent.
„ „ across „ . . .	8 „
Elongation, with the grain, ...	9 „
„ across „	3 „

One and One-Quarter Inch Thick.

Tensile strength, with the grain, ...	21 tons per sq. in.
„ „ across „	20 „ „
Contraction of area, with the grain, . .	11 per cent.
„ „ across „ . . .	6 „
Elongation, with the grain, ...	11 „
„ across „	6 „
Tensile strength, with the grain, ...	21 tons per sq. in.
„ „ across „	16 „ „
Contraction of area, with the grain, . .	14 per cent.
„ „ across „ . . .	4 „
Elongation, with the grain, ...	11 „
„ across „	2 „

The elongation was taken in every case in the standard length of 10 inches, and all the test pieces were carefully prepared to about a width of 2 inches.

Several of the higher qualities showed a considerable amount of fibre at fracture; some off the same plates were more crystalline, while others of the same batch were so decidedly crystalline that they could not be considered fit for any part of a boiler. Moreover, the tensile strength, contraction of area, and elongation, varied considerably in some cases, even when the test pieces were cut from the same plate.

Iron plates being so different in quality, no two series of tests are *exactly* alike; but the means of the foregoing results, thin and thick (*not* including the special quality) practically agree with the means of another series of tests that have been made. The tensile strength is rather more, and the contraction of area and elongation are slightly better; but this may be accounted for, as all the plates in the series described above were made or supplied with the knowledge that they would be tested; whereas in the series with which they have been compared, *it was not known that* they would all be tested, and consequently, *perhaps, the plates were not* quite so good. Unless the higher qualities

are specified for, they are not likely when tested to be found equal to anything above medium quality, and frequently might be found to be of a quality that could not be recommended for use in boilers.

If the contraction of area and elongation can be increased by lowering the tensile strength, it may be repeated that it is better to forego a ton or so in tensile strength.

Too much reliance should not be placed on any plate, unless a piece has been cut from it, and by the results of the tests it has been found suitable for the purpose intended.

Brands may be deceptive; and if the quality is judged by the stamp upon it, too frequently the result may be disappointing.

Thick iron boiler-plates are not, as a rule, very satisfactory, particularly as to ductility; hence, steel plates, which are made more ductile and of greater tensile strength, have almost superseded them.

Iron Bar Stays.

Iron manufactured by the same makers, and having the same brand, has been found, when tested, to vary considerably as regards tensile strength, elongation, and contraction of area. The following results of carefully made tests on iron supplied by different makers represent neither the worst nor the best obtainable; and while it is *not* desirable to use a quality inferior to the lowest referred to, if the results of tests are equivalent to the highest recorded here, they may be considered to represent a fair quality, such as is frequently used in good boilers.

Tensile strength, from about 21 to about 23 tons per square inch.

Elongation, from about 18 to about 25 per cent. (or even about 30 per cent.), taken in a length of 10 inches.

Contraction of area, from about 33 to about 40 per cent.; but the contraction should be more if the ends of the stays are to be riveted.

The small bars may be expected to have the greatest tensile strength and the greatest contraction of area.

The *test* pieces of the greatest diameter, if of good quality, may be expected to have the greatest elongation.

If the small sizes are of good quality, they may be expected to be more fibrous in appearance at the point of fracture than the large sizes; the latter are frequently crystalline to the extent of about 10 to 15 per cent. In the common qualities this amount is increased. The best and finest iron should be fibrous.

Iron Rivet Bars.

Rivet bars are frequently of an indifferent quality, but the following has been found to make good rivets:—

Tensile strength, about 25 tons per square inch.

Elongation, about 25 per cent., taken in a length of 10 inches; the elongation should be rather more when the diameter of the test piece is large.

Contraction of area, about 45 per cent.

The appearance of fracture fibrous.

Iron Rivets.

Tensile strength, about 25 tons per square inch.

Contraction of area, about 45 per cent.

When in single shear, the shearing resistance may be about 17 tons per square inch in plate joints; but when in double shear, it is usual to take it at 1·75 times the single shear. The single shear of the rivets in some joints is not worth more than about 16 tons, in others it may be equal to about 18 tons per square inch.

The tensile strength of rivets may be higher than those of the bars from which they are made.

The rivets should be prepared in a careful and uniform manner for testing, and the length of the part turned parallel should always be 2·5 times the turned diameter.

The appearance of fracture should be fibrous.

STEEL BOILER PLATES.

The following remarks are based on the results of carefully made tests on such plates as are used in the construction of good boilers. The plates were tested in their normal condition—that is, as they left the rolls, and not after having been annealed.

The mean tensile strength is about 29 tons per square inch.

For the shells, the tensile strength should *not* exceed 32 tons per square inch (as steel is now made), and 27 tons is low enough.

For furnaces, in those exposed to the impact of heat or flame and those to be flanged or worked, the tensile strength should *not* exceed 30 tons per square inch, and should *not* be less than 26 tons, although for *special* purposes a very good quality is made having about the same tensile strength as good wrought iron plates.

For general use throughout the boiler, 28 tons per square inch is a good tensile strength, such as is suitable for furnaces, flanging, &c., and for shells.

The mean elongation, taken in a length of 10 inches, is about 25 per cent.

The elongation, taken in a length of 10 inches, seldom exceeds 30 per cent.

The elongation, taken in a length of 10 inches, should *not* be less than 20 per cent.

As the tensile strength increases, the elongation may be expected to diminish, but plates having less than 20 per cent. elongation should not be used; about 25 per cent. elongation should be aimed at, more particularly for furnaces and flanging plates, and those exposed to the impact of heat or flame.

All plates when cold should be capable of bending to a radius of 1·5 times the thickness of the plate, and until the sides are parallel at a distance of not more than three times the thickness of the plate; but if the plates are to be used for furnaces, or to be flanged or exposed to the impact of heat or flame, they should stand bending to the same extent after being heated to a cherry-red, and at such heat plunged into water of 80° Fahrenheit, and kept in the water until the plate and water are of the same temperature.

There is no difficulty in obtaining plates which will comply with the above conditions if the test pieces are carefully prepared, and are about 2 inches broad, or even slightly less when the plates are thick, and the elongation taken in a length of 10 inches.

All steel plates should be tested before being used for boilers, and should not be annealed before the tests are made.

Brands may be delusory.

The contraction of area is generally greatest when the plates are *thick; good thick plates* may show about 48 per cent. with the grain, *and thin ones about 45* per cent.

The elongation of good thick plates may be about 27 per cent., and that of thin ones 25 per cent.

Across the grain both the contraction of area and elongation may be from about 5 to 10 per cent. less than with the grain.

The elastic limit may be expected to be about the same with and across the grain. The elastic limit of thin plates may be about 60 per cent. of the ultimate strength, and that of thick ones may only be about 50 per cent.

If a plate has a high tensile strength and only a moderate amount of contraction of area and elongation, the elastic limit may be higher than if the plate were very soft.

Steel Stay Bars.

The properties of steel stay bars vary; the following remarks refer to carefully made tests and bars within such limits as are used in good boilers:—

Tensile strength, from 27 to 32 tons per square inch.

Mean elongation, about 25 per cent. when taken in a length of 10 inches.

The elongation should not be less than 20 per cent.

The elongation seldom exceeds about 30 per cent.

The elongation should be greatest in the test pieces having the greatest diameter.

Contraction of area, from about 40 to about 50 per cent.

Steel Rivet Bars.

Mean tensile strength, about 28 tons per square inch.

The tensile strength should not be less than 26 tons per square inch.

The tensile strength should not exceed 30 tons per square inch.

The elongation should not be less than 25 per cent. when taken in a length of 10 inches, and more should be aimed at, more particularly when the diameter of the test piece is large.

The elongation seldom exceeds about 30 per cent.

The contraction of area should be as a *minimum* about 50 per cent., but about 60 per cent. should be aimed at.

All the results of the tests of the stay and rivet bars refer to tests made on bars in their normal condition—that is, not annealed; and all such tests should be made when the material is in its normal condition.

Good steel bars are made which are no stronger than iron. Pieces from each bar should be tested for tensile strength, elongation, &c.

Steel Rivets.

The results of the tensile tests of rivets are frequently slightly higher than those obtained from the bars from which the rivets are made.

The contraction of area should be from about 50 as a minimum to about 60 per cent.

The shearing strength, if of the above quality, is usually considered as 23 tons per square inch when in single shear in riveted joints, but when the rivets are in double shear they are considered to be worth 1·75 times the single shear.

The rivets should be carefully prepared for testing; the length of the part turned parallel should always be 2·5 times the turned diameter.

STEEL FOR BOILERS.

Treatment and Peculiarities.

The general physical properties of steel such as is used for boilers having been briefly dealt with in the preceding remarks, its treatment and some of its peculiarities will now be referred to.

"Doctored" Material.

The term "doctored" is used, possibly for want of one more expressive, to describe that which takes place when mild steel boiler plates, &c., are subjected to such treatment that the results of mechanical tests are considerably different after the material has been so doctored.

It has been found that the physical properties of doctored plates differ materially from those of plates tested in their normal condition—that is, as they left the rolls—*e.g.*, plates from ¼ inch to about 1¼ inch thick, which had a tensile strength of about 27 tons to 29 tons per square inch, with an elongation of about 20 to 25 per cent. in lengths of 10 inches, when tested in their normal condition, having been laid on the mill floor to cool immediately they left the rolls, had their physical properties altered by being heated to a bright red in a furnace, and then laid on the mill floor to cool, as such treatment reduced the tensile strength from about 2 to 10 per cent.; but the elongation, when compared with the elongation of the plates in their normal condition, was found to be increased from about 12 to 22 per cent. There was, moreover, a still greater difference found when the material was heated to a bright red, and allowed to remain in the furnace to cool down, as by this method the reduction in the tensile strength varied from about 6 to 17 per cent.; and the elongation, when compared with the elongation in the normal condition, was increased, except in *some* thin plates, from about 19 to 30 per cent. Makers can and do produce a quality that is not so much affected by doctoring as stated above.

When pieces from the same plates were doctored in a different way, the results of the tests made after the treatment were found to differ still further from those made when the test pieces were in the normal condition of the plates, as it was found that heating to a bright red, and then cooling in water of about 80° F. increased the tensile strength from about 11 to 29 per cent. above the tensile strength when tested in their normal condition; but the elongation in 10 inch lengths, when compared with the elongation in the normal condition, was reduced from about 26 to 80 per cent. Again, when heated in the same way, but cooled in water at about 55° F., the tensile strength was still further increased, as it was found to be from about 15 to 42 per cent. above what it was when the pieces were tested in their normal condition; and the elongation, when compared with the elongation of the pieces tested in their normal condition, was reduced from about 50 to 83 per cent.

Testing.

Unless a piece of each plate and bar be tested, so as to ascertain the physical properties of the material, steel not only irregular and indifferent in quality, but that which is of a dangerous description, may get worked into a boiler. If the results of the tests from a portion cut from the end of a plate, which is rolled of a *moderate* size, be satisfactory, it is not as a rule necessary to have further tests made from the same plate; but when the plate is large, there should be pieces cut and tested from each end of the plate, and if very large from each corner. Bars may be rolled, say 30 or 40 feet long, &c., and generally one test piece off the bar is sufficient, although the bar may be subsequently cut into two or more lengths. All test pieces should be cut off the plates and bars in their normal condition, and the pieces should be tested in their normal condition—that is, as they leave the rolls, and not after being annealed.

Plates and Bars from the same Charge.

Plates and bars made from the same charge are frequently found to vary in ductility and tensile strength. In some cases the elongation has been found to vary several hundred per cent., and the tensile strength has been below that of ordinary iron; and in other cases pieces have had a tensile strength much higher than is considered suitable for boiler construction; in some instances it has been found that the pieces which had the lowest tensile strength were also the most deficient in elongation.

Plates and Bars made from Different Parts of the same Ingot.

Plates and bars made from the same ingot, but from a different part of it, have frequently been found to vary so much, that while that made from one part of the ingot was well within the usual limits as to tensile strength and elongation, &c., that rolled from another part of the same ingot was not such as could with prudence be used in any part of a boiler.

Difference due to Temperature when Rolled.

The physical properties of plates and bars have been found to differ even when made from about the same part of the ingot. This difference may possibly be attributed to the temperature at which they were rolled, although when heated to a bright red, after being rolled and allowed to cool gradually, the difference may not exist. It is always better to avoid such doctoring, and it is more prudent to use such material as comes within the prescribed suitable limits when tested in its normal condition—that is, as it leaves the rolls, and without being annealed—as it is a more certain way of getting material of uniform and *suitable quality—material,* in short, which has not been "doctored."

ıe best way to avoid questionable material is to avoid those who ot make reliable plates without doctoring them. The majority od makers do not doctor their material.

Plates which have been Heated or Worked.

ates which are not heated uniformly in one operation, or heated worked, no matter *how* they may be heated, should after such ment be *immediately and in one operation* heated to a bright red, allowed to cool gradually. When this has not been done, plates in many instances cracked, sometimes within an hour; in other hours and days, and even weeks and months, have elapsed before plate cracked; in some cases they have cracked without being hed at the time; while in others they have cracked when struck a ıt blow, the plates being of a mild description—that is, of moderate ile strength, and having good elongation. The failures which have n place with steel plates of good quality have in nearly all cases traced to the treatment which they received; and in every case n the plate had been satisfactorily proved to be of good quality re it had been heated or worked, improper usage or want of proper tment had been the cause of failure. Steel should not be worked n hot below a red heat.

Flanging.

ll flanging, so far as practicable, should be done in one operation; raulic appliances are the most desirable, and the plate *immediately* r it has been flanged should be heated to a bright red, and allowed ool gradually.

Bending Plates when Cold.

lates should be bent when they are cold to the required curvature cylindrical shells, receivers and domes, &c. Plates which will not ıd bending when cold should not be used; there are rolls well pted for such work, being capable of bending large plates, and ker than any yet used for shells of boilers.

Welding.

ıny part of a boiler which is to be subjected to a tensile strength uld not be welded. Although welds in tension are very uncertain even dangerous, they may not be so when subjected to a compressive ss, such as in the longitudinal seams of furnaces, but after being ded the whole should be efficiently annealed.

Drilling and not Punching.

'lates should not be punched, as such treatment has been found not y to impair *the strength of the* material, but also to make it *gerously unreliable, which is* much more serious than if it only

reduced the tensile strength. With suitable drilling applia boilers can be constructed at less cost than by the barbarous m of punching the holes; and no boiler works can now be considere first-class establishment which has not suitable appliances for dr the holes in place. It has been proved, in several good boiler w that the cost of construction is less when the holes are drill suitable machines than when they are punched, Good machine be obtained, which will soon repay the outlay, and ultimately ef saving of labour; moreover, a reliable and safe boiler can be turned instead of one in which, when the holes are punched, no confi can be placed, and which may explode without giving warning, th the material having been ruined by punching.

Steel Serviceable and Reliable.

Notwithstanding the peculiarities of mild steel, it is a material may be used with safety and advantage, if proper precautions be and due consideration given to these peculiarities ; possibly i fewer infirmities than iron ; and there can be no doubt that it is a l and more serviceable material for general use in the construct boilers.

IRON BOILERS.

Cylindrical Shells.

Iron as our oldest friend has the first place in this section, although our comparatively new acquaintance, Steel, may merit equal if not more consideration.

The shells of cylindrical iron boilers before they can be considered first-class should be made of the best quality of iron plates. All the seams should be at least double riveted, and fitted with double butt straps; all the rivet holes should be drilled after the plates are bent and bolted in place, and the holes in the butt straps should be countersunk with a *slight* taper from the outside (about three-fourths the thickness of the butt strap), and the plates afterwards taken apart and the burr removed before they are riveted up; the minimum thickness of each butt strap should never be less than five-eighths the thickness of the shell plate, but may require, both for strength and to ensure a steam-tight joint, to be considerably thicker;* the allowance for rivets in double shear should not exceed 1·75 times that for single shear.

If the foregoing conditions have been complied with, and the boiler has been efficiently inspected during the whole period of construction, and it is in all other respects satisfactory, then 5 may be used as a *nominal* factor of safety in finding the working pressure.

From what follows it will be seen that under certain circumstances additions should be made to the *nominal* factor 5, varying according to the circumstances of the case; but when the plates are thick and the holes punched, it is desirable that a higher factor than 5 be used to commence with.

If, instead of being fitted with double butt straps, and at least double riveted, the circumferential seams are lap and at least treble riveted, it need not prevent the factor 5 being used, if the circumstances of the case make it desirable to do so; but in such cases the percentage strength of the circumferential seams should not be less than 65 per cent. of the solid plate. This applies principally to the middle seams, but not necessarily to the end seams.

The tensile strength of the iron may be considered as equal to 47000 pounds per square inch with the grain, and 40000 pounds across the grain. But if the foregoing conditions be not complied with, the additions in the following table should be made to the *nominal* factor 5, according to the circumstances of each case, and the sum, 5 *plus* the appropriate additions, used as the nominal factor in calculating the working pressure.

The *nominal* factors are factors of safety and not of economy, and it would be to the ultimate pecuniary interest of boiler owners were they increased; except in cases where lightness is of paramount importance, the cost of the extra weight of material would be small in comparison with the ultimate saving.

* The *minimum thickness of the* butt straps can be ascertained, and the distance *between rows of rivets should be* proportioned in accordance with the formulæ *applicable to the particular* description of riveting, which will be found further on

Table of Additions.

Longitudinal Seams.	† A When all the holes are fair and good in the longitudinal seams, but drilled out of place after bending, ... add But if all the holes be afterwards bored or rimered out in place, and are as fair as if they had been drilled in place, A may be omitted.	·15	A
	† B When all the holes are fair and good in the longitudinal seams, but drilled out of place before bending, ... add But if all the holes be afterwards bored or rimered out in place, and are as fair as if they had been drilled in place, B may be ·2.	·3	B
	† C When all the holes are fair and good in the longitudinal seams, but punched after bending, ... add But if all the holes be afterwards bored or rimered out, and are as fair as if they had been drilled in place, C may be ·2.	·3	C
	† D When all the holes are fair and good in the longitudinal seams, but punched before bending, ... add But if all the holes be afterwards bored or rimered out in place, and are as fair as if they had been drilled in place, D may be ·4.	·5	D
	* E When all the holes are not fair and good in the longitudinal seams, at least . . add	·75	E
Circumferential Seams.	† F When all the holes are fair and good in the circumferential seams, but drilled out of place after bending, ... add But if all the holes be afterwards bored or rimered out in place, and are as fair as if they had been drilled in place, F may be omitted.	·1	F
	† G When all the holes are fair and good in the circumferential seams, but drilled before bending, ... add But if all the holes be afterwards bored or rimered out in place, and are as fair as if they *had been drilled* in place, G may be ·1.	·15	G

Table of Additions—*continued.*

Circumferential Seams.	†H	When all the holes are fair and good in the circumferential seams, but punched after bending, ... add	·15	H
		But if all the holes be afterwards bored or rimered out in place, and are as fair as if they had been drilled in place, H may be ·1.		
	†I	When all the holes are fair and good in the circumferential seams, but punched before bending, ... add	·2	I
		But if all the holes be afterwards bored or rimered out in place, and are as fair as if they had been drilled in place, I may be ·15.		
	J	When all the holes are not fair and good in the circumferential seams, at least . . add	·2	J
Longitudinal Seams.	K	When double butt straps are not fitted to the longitudinal seams, and the said seams are lap and double riveted, . . . add	·2	K
	L	When double butt straps are not fitted to the longitudinal seams, and the said seams are lap and treble riveted, . . . add	·1	L
	M	When only single butt straps are fitted to the longitudinal seams, and the said seams are double riveted, ... add	·3	M
	N	When only single butt straps are fitted to the longitudinal seams, and the said seams are treble riveted, ... add	·15	N
	O	When any description of longitudinal joint is single riveted, ... add	1.	O
Circumferential Seams.	P	When the circumferential seams are fitted with single butt straps and are double riveted, add	·1	P
	Q	When the circumferential seams are fitted with single butt straps and are single riveted, add	·2	Q
	R	When the circumferential seams are fitted with double butt straps and are single riveted, add	·1	R
	S	When the circumferential seams are lap and are only double riveted, . . . add	·1	S
	T	When the circumferential seams are lap and are *single riveted*, ... add	·2	T

Table of Additions—*continued.*

Circumferential Seams.	U When the circumferential seams are lap, and the strakes of plates are not entirely under or over, ... add	·25	U
	V When the boiler is of such a length as to fire from both ends, or is of unusual length, such as flue boilers, and the circumferential seams are fitted as described opposite, P, R and S, ... add	·3	V
	When the circumferential seams are as described opposite Q and T, V ·3 should become V ·4. But V may be omitted altogether if the circumferential seams be treble riveted and lap, and at least equal to 65 per cent. of the solid plate.		
	W When the seams are not properly crossed, add	·4	W
	X When the iron is in any way doubtful, and the Engineer Inspector is not satisfied that it is of the best quality, at least . . . add	·4	X
	§ Y When the boiler is not specially inspected during the whole period of its construction, . add	1·65	Y

* Where marked with an asterisk, it may be advisable to increase the additions to the nominal factor still further, if the workmanship or material be very doubtful or very unsatisfactory; or when the iron plates are very thick, it may be advisable to add something more, particularly if the joints be lap, as is stated in the paragraphs immediately preceding the table of additions.

† When the holes are bored or rimered out in place, the case should be carefully considered, as the circumstances may warrant a reduction of the additions of A, B, C, D, F, G, H, or I, to the extent stated in the table.

§ Iron boilers that have not been *specially* inspected by the Engineer Inspector during the whole period of construction should be particularly examined, and the whole circumstances carefully considered, with the view of determining what additions should be added and the nominal factor that should be used; the addition *Y being equal to* $D+E+I+J$ or $·5+·75+·2+·2$ equals 1·65.

Riveted Joints of Cylindrical Shells, Receivers, Domes, &c. (Iron).

The diameter of the rivets should never be less than the thickness of the plate, and in most cases should be greater.

When the plates are thin, or when joints are lap, or when only a single butt strap is fitted, the diameter of the rivets should always exceed the thickness of the plate.

The actual shearing strength of rivets is about five-sixths the tensile strength of the plate, but in iron plate joints it is usual to assume the shearing strength of the rivets as being equal to the tensile strength of the plate, and on this assumption the percentage strength of any joint or other particulars of the joint may be found by the following formulæ :—

p = Pitch of rivets in inches.
d = Diameter of rivets in inches.
A = Area of one rivet in square inches.
n = Number of rivets in one pitch (greatest pitch).
p_D = Diagonal pitch in inches.
V = Distance between rows of rivets in inches.
% = Percentage of plate left between rivets in greatest pitch.
$\%_1$ = Percentage of rivet section as compared with solid plate.
$\%_2$ = Percentage of combined plate and rivet section when the number of rivets in the second row is twice that in the outer row.
c = 1 For lap or single butt strap joints.
c = 1·75 For double butt strap joints.
T = Thickness of plate in inches.

To find the percentage strength of any given joint—

$$\frac{100(p-d)}{p} = \% \quad . \quad . \quad . \quad (1)$$

$$\frac{100 \times A \times n \times c}{p \times T} = \%_1 \quad . \quad . \quad . \quad (2)$$

When the number of rivets in the second row is twice that in the outer row—

$$\frac{100(p-2d)}{p} + \frac{\%_1}{n} = \%_2 \quad . \quad . \quad . \quad (3)$$

The lowest of the values so found is the percentage strength of the joint.

The formula (3) is given, although its use will seldom be found necessary. In double butt strapped joints % or $\%_1$ is always less than $\%_2$ so long as the diameter of the rivet is not less than the thickness of the *plate, and in lap joints* when the diameter is not less than $\frac{T}{\cdot 7854}$.

To find d when p, n, c, T are known so that % may be equal to $\%_1$—

$$\sqrt{\frac{T}{1{\cdot}57\times n\times c}\left\{\frac{T}{1{\cdot}57\times n\times c}+2p\right\}}-\frac{T}{1{\cdot}57\times n\times c} = d \qquad (4)$$

To find p when d, n, c, T are known so that % may be equal to $\%_1$—

$$\frac{A\times n\times c}{T}+d = p \quad . \quad . \quad . \quad (5)$$

To find d and p when n, c, T and the required percentages are known—

$$\frac{\%\times T}{(100-\%)\times {\cdot}7854\times n\times c} = d \quad . \quad . \quad (6)$$

$$\frac{100\times\%\times T}{(100-\%)^2\times {\cdot}7854\times n\times c} = p \quad . \quad . \quad (7)$$

Rivets and Plate of Equal Strength (Iron).

If it be desired to construct the joints so that the shearing strength of the rivets may be equal to the tensile strength of the plates, equation (2) and the first term of equation (5) should be multiplied by $^5/_6$, and equation (6) and (7) by 1·2; 1·309 should be substituted for 1·57 in equation (4), and equation (3) becomes applicable to lap joints when the diameter of the rivets is less than $\frac{T}{{\cdot}6545}$.

Diagonal Pitches (Iron).

In any case the diagonal pitch, p_D, between the outside and the next row of rivets should not be less than is found by the following formula:—

(1) Ordinary zigzag riveting, and chain riveting when each alternate rivet is omitted in the outside row—

$${\cdot}6p+{\cdot}4d = p_D.$$

$$\frac{\sqrt{(11p+4d)(p+4d)}}{10} = V.$$

But V should not be less than $\frac{4d+1}{2}$ in chain riveted joints.

(2) Zig-zag riveting, when each alternate rivet is omitted in the outside row—

$${\cdot}3p+d = p_D.$$

$$\frac{\sqrt{(11p+20d)(p+20d)}}{20} = V.$$

The value of the metal in the diagonal pitch is only about five-sixths of what it is in the horizontal pitch; therefore the net section in the diagonal pitch should be one-fifth greater than it is in the horizontal pitch, or in the part of the horizontal pitch to which it is required to *be equivalent in strength.*

Iron Butt Straps.

Butt straps should always be cut from plates, and not from bars; they should be of as good a quality as the shell plates, and for the longitudinal seams should be cut across the fibre.

When the plates are drilled in place, the butt straps should also be drilled in place, and after drilling they should always be taken apart, the burr taken off, and the holes in the straps countersunk with a slight taper from the outside.

Double Butt Straps (Iron).

When double butt straps are fitted, each butt strap should not be less than five-eighths of the thickness of the shell plate, but it may be necessary to have them thicker. With wide pitches an efficient and tight joint cannot be made unless the butt straps are sufficiently thick, and the thickness of each in such cases should considerably exceed five-eighths of the thickness of the shell plate.

When the pitch is not the same in each row, or the rivets in each row are not the same size, the thickness of the butt straps requires to be increased to obtain the strength as well as to enable a tight joint to be made.

The minimum thickness of butt straps is found from the following formulæ:—

Thickness of Butt Straps (Iron).

P = Pitch of rivets in outside row of rivets.
d = Diameter of rivets in inches.
T = Thickness of plate in inches.
T_1 = Thickness of each butt strap in inches (minimum).

When the pitch of rivets is the same in each row—

$$\frac{5 \times T}{8} = T_1 \text{ Double butt straps.}$$

$$\frac{9 \times T}{8} = T_1 \text{ Single butt straps.}$$

When the pitch of rivets in the outside row is double that in the row next the butt of plates—

$$\frac{5(p-d) \times T}{8(p-2d)} = T_1 \text{ Double butt straps.}$$

$$\frac{9}{8}\left(\frac{p-d}{p-2d}\right) \times T = T_1 \text{ Single butt straps.}$$

Pressures, &c., on Cylindrical Shell, &c. (Iron).

Unless the iron plates be proved to possess superior qualities, as to *elongation and contraction* of area, and with such ductile properties to

have a tensile stress exceeding 21 tons per square inch, they should not be assumed to have a greater tensile strength than 47000 lbs. per square inch. The smallest of the percentages as found by the preceding formulæ (1) (2) or (3) should be used as the percentage strength of the joint, and the *nominal* factor of safety should not be less than that found from the preceding table and the paragraph immediately preceding it (*see* pages 17, 18, 19, and 20).

The working pressure should not exceed that found by the following formula:—

T = Thickness of plate in inches.
D = Inside diameter of boiler in inches.
F = Factor of safety.
r = Lowest of the percentages $\%$ $\%_1$ $\%_2$ divided by 100.
B = Working pressure per square inch in lbs.

$$\frac{47000 \times r \times 2T}{D \times F} = B$$

$$\frac{B \times D \times F}{47000 \times 2 \times r} = T$$

$$\frac{47000 \times r \times 2T}{B \times F} = D$$

$$\frac{47000 \times r \times 2T}{D \times B} = F$$

$$\frac{B \times D \times F}{2T \times 47000} = r.$$

Iron boiler plates which are to be subjected to flame or to the impact of heat should be of suitable quality, and those equal to what follows may be considered so: tensile strength with the grain about 21 or 22 tons per square inch, contraction of area about 20 per cent. and elongation about 16 per cent.; across the grain, tensile strength about 19 tons per square inch, contraction of area about 12 per cent. and elongation 10 per cent., when the specimens are tested in strips 2 inches wide and the elongation taken in a length of 10 inches. The plates for furnaces, combustion boxes, and all parts exposed to the direct impact of flame and heat should not be of a low quality.

Iron plates may be considered suitable for the shells of boilers, if not exposed to flame and the direct impact of heat, and if not to be flanged, if they have a tensile strength with the grain of about 21 or 22 tons and across the grain of about 18 tons per square inch, with a contraction of area and elongation slightly less than that for furnace plates; but when the plates are about three-quarters of an inch thick and upwards, they are not generally quite so good. In another part will be found some remarks as to iron boiler plates (*see* p. 4 *et seq.*), from which it will be seen that better qualities of plates can be made, but better qualities than those given above are seldom *guaranteed by really good* makers except at a very high price.

Curved Ends of Cylindrical Iron Boilers.

When the ends of cylindrical boilers are curved to join the shell, the working pressure should not exceed that found by the following formula :—

R = Radius of curved end in inches.
d = Diameter of tubes outside in inches.
T = Thickness of tube plate in inches.
p = Pitch of tubes in inches horizontally.
% = Percentage of iron left between each tube as compared with the solid plate of a length equal to p.
C = 9500 when the stress is with the grain of the iron.
C = 8000 when the stress is across the grain of the iron.
B = Boiler pressure per square inch in lbs.
r = Percentage of plate section (%) divided by 100.

$$\frac{100(p-d)}{p} = \%$$

$$\frac{100d}{100-\%} = p$$

$$\frac{C \times r \times T}{R} = B \dagger *$$

$$\frac{R \times B}{C \times r} = T *$$

As all the tube plates are more or less injured by expanding or drifting the tubes, the above constants should be considered as maximum ones, and when the iron is not of very good quality, both as regards tensile strength and ductility, the constants should be reduced from 9500 to about 7500, and from 8000 to about 6500.

Cylindrical Superheaters (Iron).

The strength of the joints of cylindrical superheaters and the factor of safety should, when made of the best quality of iron plates, be found in a similar manner as for cylindrical boilers and steam receivers, but instead of using 47000 lbs. as the tensile strength of iron, 30000 lbs. should be used; where the heat or flame impinges at or nearly at right angles to the plate, 22400 lbs. should be substituted.

When a superheater is constructed with a tube subject to an external or collapsing pressure, the working pressure should be ascertained in the same way as the working pressure for circular furnaces, but the

* If the percentage strength of the horizontal riveted seam above the tubes be less than the percentage of plate left between the tubes, it should be used in the above formula for calculating the working pressure, &c.

† If the thickness of the curved plate be less than that of the tube plate, the percentage left in each should be multiplied by its respective thickness, and the lesser of the two values used in place of $r \times T$, as given in the formula.

constants should be reduced at least 36 per cent., and if much flame passes through the tube it may be necessary to reduce the constants a great deal more, as the iron plate when hot may be less than about one-fifth of the strength of the cold plate.

When superheaters are constructed so that they cannot be entered on account of their size, &c., they should have a sufficient number of openings through which a thorough inspection of the whole of the interior can be made, and the doors for these openings should be made and secured in the same way as manhole and mudhole doors, and the openings stiffened and strengthened in like manner.

When a superheater can be shut off from the main boiler or boilers it should be fitted with a safety valve of sufficient size, and so constructed that the pressure on it cannot be increased when steam is up.

The least size of safety valve on a superheater, unless there be some very good reason to the contrary, should be 3 inches diameter.

Drain pipes should in all cases be fitted to each superheater in which a collection of water in the bottom is possible; a drain pipe is also desirable to allow of any mud being washed away.

Circular Iron Furnaces.

The working pressure on plain circular furnaces, when they are *horizontal*, and made of wrought iron plates of the best quality, should not exceed that found by the use of the constants and formula which follow, provided the pressure so found does not exceed that arrived at by the use of the formula $\frac{8000 \times T}{D}$

D = Outside diameter of furnace in inches.

*L = Length of furnace in feet.

T = Thickness of plate in inches.

B = Working pressure per square inch in pounds, which should not exceed that found by the formula $\frac{8000 \times T}{D} = B.$

C = Constant according to the circumstances of the case, the values of which are as follows :—

Furnaces with Welded Seams or Butt Joints and Drilled Rivet Holes.

When the longitudinal seams are welded, ... C = 90000

When the longitudinal seams are double riveted and fitted with single butt straps, ... C = 90000

When the longitudinal seams are single riveted and fitted with single butt straps, ... C = 80000

When the longitudinal seams are single riveted and fitted with double butt straps, ... C = 90000

* The length should be measured between the rings, Bowling hoops, &c., if so fitted.

nces with Butt Joints and Punched Rivet Holes.

n the longitudinal seams are double riveted and ith single butt straps, ... C=85000
n the longitudinal seams are single riveted and ith single butt straps. . . . . C=75000
n the longitudinal seams are single riveted and ith double butt straps, ... C=85000

nces with Lapped Joints and Drilled Rivet Holes.

n the longitudinal seams are double riveted and l, ... C=80000
n the longitudinal seams are double riveted and elled, ... C=75000
n the longitudinal seams are single riveted and l, ... C=70000
n the longitudinal seams are single riveted and elled, ... C=65000

nces with Lapped Joints and Punched Rivet Holes.

n the longitudinal seams are double riveted and l, ... C=75000
n the longitudinal seams are double riveted and elled, ... C=70000
n the longitudinal seams are single riveted and d, ... C=65000
n the longitudinal seams are single riveted and elled, ... C=60000

following formula for the working pressure is intended for s up to about 10 feet long and of ordinary diameters, and when gth exceeds that, it is advisable in all cases to fit strengthening hoops, &c. :—

$$\frac{C \times T^2}{(L+1) \times D} = B^*$$

$$\frac{C \times T^2}{(L+1) \times B} = D$$

$$\sqrt{\frac{(L+1) \times D \times B}{C}} = T$$

$$\frac{C \times T^2}{D \times B} - 1 = L$$

$$\frac{(L+1) \times D \times B}{T^2} = C.$$

working pressure should not exceed that found by the limiting formula). The pressures arrived at by the use of the Tables Nos. 66 to 77 may

Vertical Furnaces or Fire Boxes (Iron).

In the case of upright fire boxes of donkey or similar boilers, 10 per cent. should be deducted from the constants applicable to the respective classes of work, description of seam or joint; but a greater reduction should be made if the diameter does not decrease at least one inch per foot of height.

Curved Tops of Combustion Boxes (Iron).

The curved tops of combustion boxes, on account of the want of continuity, are not capable of withstanding nearly the same pressure as a complete cylinder of the same radius, and should be stiffened by T bars. The constants for plain cylindrical furnaces, when applied to the top of combustion boxes, should be considerably reduced; the tops of combustion boxes have been known to come down at about half the pressure suitable for a round furnace having the same thickness of plate and radius.

The curved tops of combustion boxes should be efficiently stayed to the end of the boiler; and when there are double combustion boxes, back to back, they should be efficiently tied together. The length of the box in inches, multiplied by the radius of curvature in inches, is the least surface in square inches for which stay power is required; but it may be necessary to provide more stay power if the longitudinal stays are not sufficient to support the end plates to about the level of the top of the combustion boxes.

It is desirable that the radius of curvature be not less than the width of the box, in order to avoid, as far as practicable, any flat surface on the top corner next the tube plate.

The plates should be of a very good quality.

Corrugated Iron Furnaces.

The working pressure for corrugated furnaces made of the best quality of iron plate, provided they are practically circular, and machine-made, and the plain parts at the ends do not exceed 6 inches in length, and the plates not less than $\frac{5}{16}$ inch thick, when new, should not be greater than found by the following formula, where

T = Thickness of plate in inches.
D = Mean diameter in inches.
C = 9000.
B = Working pressure per square inch in lbs.

$$\frac{C \times T}{D} = B$$

$$\frac{C \times T}{B} = D$$

$$\frac{B \times D}{C} = T.$$

ı a furnace is riveted in two or more lengths, the case should be ısidered, as it may not be prudent to allow the same pressure . there is no circumferential seam.

›orrugated furnaces should be made of plates of the very best and free from laminations, otherwise they will probably very ›come defective, and necessitate portions being cut out and put on ; it is therefore most desirable, when iron is used, that late be tested and also carefully examined, both before and after rrugated. If this be not particularly attended to, trouble is ensue, and great expense will be caused by renewing the ɜ.

Flat Surfaces (Iron).

›ressure on wrought iron plates forming flat surfaces should not that found by the following formula, but when the surface is ıuch as is the case in launch boilers and several descriptions of ›ilers, the pressure found in the tables in another part is that hould be used.

›ressure in all cases may be taken from the tables Nos. 2 to 30, 'aces, iron plates, but in the case of small pitches the pressure always be taken from the tables, and not arrived at by the

'hickness of the plate in sixteenths of an inch.
urface supported in square inches.
Vorking pressure in pounds per square inch.
'onstant according to the following circumstances :—

	Constants.
60. When the plates are not exposed to the impact of heat or flame, and the stays are fitted with nuts and with doubling strips not less in width than two-thirds the pitch of the stays, and not less in thickness than the plates they cover, and are riveted to the plates, ...	160
50. When the plates are not exposed to the impact of heat or flame, and the stays are fitted with nuts and with washers of not less diameter than two-thirds the pitch of the stays, and not less in thickness than the plates they cover, and are riveted to the plates, ...	150
00. When the plates are not exposed to the impact of heat or flame, and the stays are fitted with nuts and with washers, the latter being at least three times the diameter of the stay and two-thirds the thickness of the plates they cover, .	100
90. When the plates are not exposed to the impact of *heat or flame, and the* stays are fitted with nuts *only,*	90

	Constants.
C = 60. When the plates are exposed to the impact of heat or flame, and steam is in contact with the plates, and the stays fitted with nuts and washers, the latter being at least three times the diameter of the stay and two-thirds the thickness of the plate they cover, . . .	60
C = 54. When the plates are exposed to the impact of heat or flame, and steam is in contact with the plates, and the stays are fitted with nuts only,	54
C = 80. When the plates are exposed to the impact of heat or flame, with water in contact with the plates, and the stays screwed into the plate and fitted with nuts, ...	80
C = 60. When the plates are exposed to the impact of heat or flame, with water in contact with the plates, and the stays screwed into the plates having the ends riveted over to form substantial heads, ...	60*
C = 36. When the plates are exposed to the impact of heat or flame, and steam is in contact with the plates, with the stays screwed into the plates, and having the ends riveted over to form substantial heads, ...	36

When doubling plates of not less thickness than the plates they cover are riveted on outside, and cover the plates, the pressure found by the use of the constant 160 may be increased by about 25 per cent., but such a method of construction is not considered the best; and whenever doubling plates are fitted to cover the whole of the flat surface, the circumstances of the case should be *specially* considered.

The values of the letters in the following formulæ will be found immediately preceding the table of constants:—

$$\frac{C \times (t+1)^2}{S-6} = B$$

$$\frac{B \times (S-6)}{(t+1)^2} = C$$

$$\frac{C \times (t+1)^2}{B} + 6 = S$$

$$\sqrt{\frac{B \times (S-6)}{C}} - 1 = t.$$

When the stays are screwed into the plates and the ends riveted, the Engineer Inspector should see that the stays are a good fit; for if they

* When there is neither flame nor heat impinging on the plates, and water is in contact with the plates on one side, such as the outside shell or ends of the boiler, *the pressure found by the constant* 60 may be increased about 12 per cent., if *after specially considering the* case it is thought advisable to do so.

not, the pressure, as found by the formula and appropriate constant, by the tables which are in another part, should be reduced ; the)unt of such reduction should be settled according to the circum- ices of the case.

Vhen the ends of riveted stays are worn, or any of the nuts are nt, the Engineer Inspector should be particularly careful as to the ssure he allows the boiler to be worked at, since it may be necessary educe the constant 60 by one half or even more, so as to insure that pressure is not too great ; but in all such cases, if it be possible, stays and nuts should be fitted rather than work, even for a short e, at a reduced pressure ; neglect of such easily remedied imperfec- is has frequently resulted in disastrous explosions.

f a plate be cracked at the hole for the stay, the piece should be cut and a washer or plate riveted on and caulked, the stay should enewed by a larger one, and screwed into the washer, and the ends ted or nuts fitted ; the latter is far the better way. If nuts are perly fitted, and proper fire bars used, those in the furnaces will as a rule get burned off unless through carelessness or want of ntion. This more particularly applies to marine boilers with ural draught, and not to boilers in which forced draught is used.

Vhen stays are screwed into the plates, the tap used should be long ugh to tap both plates.

'he iron of which screwed stays are made should be of a particularly and ductile quality, more particularly when the ends are to be ted, otherwise the riveted heads will be of little or no use, and the eads will probably be so damaged as to greatly impair the efficiency he stay. Cold-short iron should not be used.

'he plates forming flat surfaces are sometimes stiffened with T or L s, but such a method of construction has many disadvantages and advantages, except when used round manhole or mudhole openings ; vever, if they be used, little allowance should be made for them, and n only after specially considering the case.

Direct Iron Stays for Flat Surfaces.

'here should not be a greater stress on solid wrought iron screwed ys which support the flat surfaces of boilers, than 7000 lbs. per are inch of net section, but the stress should not exceed 5000 when the stays have been welded or worked in the fire. Stays ich have the ends "jumped on" are not reliable, and should never be d ; palm ended stays are objectionable ; welded stays are not irable. It is advisable, even when solid wrought iron screwed stays used, not to have a greater stress on them, when new, than about 5000 per square inch, and about 4000 lbs. on welded or worked stays ; extra cost, at first, will ultimately be more than saved to those o have to pay for renewals and repairs of boilers.

'he size of stay, &c., may be found by the following formulæ or n the tables, Nos. 31 et seq.:—

A = Surface to be supported in square inches.
S = Stress on stays per square inch of net section in lbs.
B = Pressure (working) per square inch in lbs.
a = Area of stay in square inches.
d = Diameter of stay at bottom of thread in inches.

$$\frac{A \times B}{S} = a$$

$$\sqrt{\frac{a}{\cdot 7854}} = d$$

$$\frac{S \times a}{B} = A$$

$$\frac{A \times B}{a} = S$$

$$\frac{S \times a}{A} = B.$$

When a stay is attached by bolts or rivets, the aggregate area of the bolts or rivets should exceed the area of the stay.

When a stay is attached by bolts or rivets, and they are subjected to a single shearing stress, their area should be about 20 per cent. more than the stay; but if subjected to double shear, their area may be about 25 per cent. less than the stay; if the stay be welded, the 20 per cent. may be reduced to 10 per cent. and the 25 per cent. increased to 30 per cent.

Direct Stays attached to Wrought Iron Cross Bars or Beams.

When a direct stay is attached to the centre of a wrought iron cross bar or beam, and the cross bar or beam is attached by two smaller stays to the plate, the aggregate area of the small stays should be about 25 per cent. more than the area of the main direct stay.

The working pressure, breadth, depth and length of the wrought iron cross bar or beam can be found by the following formula:—

B = Working pressure per square inch in pounds.
b = Breadth of beam in inches *minus* the diameter of the hole in inches for main stay.
*D = Depth of beam in inches.
L = Length of beam from centre to centre of small stays in feet.
S = Surface in square inches to be supported.
C = 500.

* *The total breadth of such* cross bars or beams is generally considerably in *excess of their depth.*

$$\frac{C \times D^2 \times b}{S \times L} = B$$

$$\frac{C \times D^2 \times b}{L \times B} = S$$

$$\frac{C \times D^2 \times b}{S \times B} = L$$

$$\sqrt{\frac{B \times S \times L}{C \times b}} = D$$

$$\frac{B \times S \times L}{C \times D^2} = b.$$

All the holes in the cross bar should be carefully drilled, so that they are made all true with the faces of the cross bar, and so that all the nuts on each face will bed properly. The end holes should be exactly equidistant from the centre of centre hole; care should also be taken that the small stays are fitted in so that they are parallel. If this be not attended to, undue stress will be put upon them when there is a strain on the main stay; it is also essential to have each set of small stays exactly opposite each other, for if not, they will be unduly strained when a stress comes on the main stay.

Diagonal Iron Stays.

The area of diagonal stays should not be less than that found in the following manner:—

First find the area of a direct stay needed to support the surface, then multiply this area by the length of the diagonal stay, and divide the product by the length of a line drawn at a right angle from the surface to be supported to the end of the diagonal stay; the quotient will be the area at the smallest part of the diagonal stay required, or it may be found by the following formulæ:—

a = Area required for a direct stay in square inches.
H = Length of diagonal stay in inches.*
L = Length of line drawn at a right angle from the surface to be supported to the end of the diagonal stay in inches.
a_1 = Area of diagonal stay in square inches.
d = Diameter of diagonal stay in inches.
A = Surface to be supported in square inches.
S = Working stress per square inch on stay in lbs.
B = Working pressure in lbs.

* *Although H and L are given in inches, feet may be used if both H and L are used in terms of feet.*

$$\frac{a \times H}{L} = a_1$$

$$\frac{a_1 \times L}{a} = H$$

$$\sqrt{\frac{a_1}{\cdot 7854}} = d$$

$$\text{or } \sqrt{\frac{a \times H}{\cdot 7854 \times L}} = d$$

$$\text{or } \sqrt{\frac{A \times B \times H}{\cdot 7854 S \times L}} = d.$$

$$\frac{\cdot 7854 \times d^2 \times S \times L}{A \times H} = B.$$

When the palm end of a diagonal stay is attached to the shell, the area of the rivets or bolts, subjected to single shear, should have an aggregate area of about 20 per cent. greater than the stay; if, however, the end is so made as to be attached between two angle bars, the bolt or pin may have an area of about 25 per cent. less than the diagonal stay, but the area of the rivets attaching the angle bars to the shell should be about 20 per cent. greater than the area of the diagonal stay.

It is desirable that all diagonal stays be forged and worked out of the solid; but when this is not done, and they are welded or if the holes in the palms or ends are punched or drifted, instead of being drilled so as to entitle them to be considered as first class, the additional rivet area, as stated in the foregoing, may be 10 per cent. instead of 20 per cent.; and the reduction of area, when the bolts, pins, &c., are in double shear, may be about 30 per cent. instead of 25 per cent. Punching the holes is very objectionable.

Diagonal stays are not recommended except when direct stays cannot be fitted; when they are used they should be well made, properly fitted, and specially looked after by the Engineer Inspector.

The ends of diagonal stays should not be bent, and bevelled washers should be fitted under the nuts inside and outside the boiler.

The palm ends of diagonal stays should be forged out of the solid, and the holes in the palm should be drilled, and either the shell drilled when the stay is in place, or the shell may be drilled first and the stay drilled in place.

Ends "jumped on" are not only objectionable, but dangerous.

The length of diagonal stays should be as great as practicable.

The most desirable and efficient method of fitting diagonal stays, when it is necessary that they should be used, is to have a palm on one end riveted to the shell, and the other end screwed and having *nuts inside and outside the* boiler, with properly fitted bevelled washers *under the nuts.*

Stays in General (Direct and Diagonal).

The stays should be well fitted, and each one carefully tightened, and, as far as possible, every stay in a group should have the same normal strain on it. If care be not taken in fitting and tightening up stays they are liable to give way, and with them the plates to which they are attached, owing to too much strain coming on one stay.

When diagonal stays are fitted it is particularly necessary to see that the bolts or rivets by which they are secured are made to fit properly, so that each has only its fair amount of strain. Stays should not be reduced in the body. When a strain comes on those which are so reduced they stretch more than stays which are of the same diameter all over as at the top of the threads of the screwed parts, and such stretching is very injurious to the boiler; moreover, stays in almost every case corrode in the body, and not at the screwed ends. Besides, not being as efficient, such stays require renewing much sooner, which is expensive, the original cost for properly proportioned stays being much the same, and the increased weight very little.

Gusset Iron Stays.

When gusset stays are used, their area should be considerably in excess of that required for diagonal stays.

When a gusset stay is attached between double angle bars (which they should always be in preference to a single angle bar) the aggregate area of the rivets attaching the angle bars to the shell should be about 20 per cent. greater than that required for a diagonal stay, and the aggregate area of the rivets which attach a gusset to a single angle bar should also be about 20 per cent. greater than that required for a diagonal stay; but the area of the rivets when the gusset stay is attached between two angle bars, the rivets being in double shear, may be about 25 per cent. less than the area required for a diagonal stay.

Gusset stays have many disadvantages, and only one advantage as compared with direct stays; but as a diagonal stay can be used in most cases where a gusset stay can, it should be used in preference; but solid screwed direct stays should be fitted wherever it is practicable, as they are by far the best and most reliable.

When, however, gusset stays are used they should be fitted properly; the holes in them and in the angle bars rimered out when in place, and the rivets should fit well; care should be taken that the angle bars are placed at the proper distance apart, so that the gusset plate is a good fit between the sides of the angle bars.

A good quality of plate should always be used, and the holes should not be punched but drilled for the rivets; the edges of the plate should have a sufficient quantity planed off so as to insure that the injury caused by shearing is removed.

Girders for Flat Surfaces (Iron).

When the tops of combustion boxes or other parts of a boiler are supported by wrought iron plates or solid wrought iron rectangular girders; provided that the girders are not subjected to a greater temperature than the ordinary heat of steam, and, in the case of combustion chambers, that the ends are properly fitted to the edges of the tube plate, and the back plate of the combustion box, or to the tube plates when the boiler is fired from each end, and the combustion box is in the middle; the working pressure should not exceed that found by the following formula :—

W = Width of combustion box in inches.
P = Pitch of supporting bolts in inches.
D = Distance between the girders from centre to centre in inches.
L = Length of girder in feet.
d = Depth of girder in inches.
T = Thickness of girder in inches.
B = Working pressure per square inch in lbs.
C = 500 when the girder is fitted with one supporting bolt.
C = 750 when the girder is fitted with two or three supporting bolts.
C = 850 when the girder is fitted with four supporting bolts.

The working pressure for the supporting bolts and for the plate between them should not exceed that found by the formulæ for direct stays and flat surfaces, or by the Tables Nos. 41 and following.

$$\frac{C \times d^2 \times T}{(W-P)D \times L} = B$$

$$\sqrt{\frac{(W-P)D \times L \times B}{T \times C}} = d$$

$$\frac{(W-P)D \times L \times B}{d^2 \times C} = T$$

$$\frac{d^2 \times T \times C}{(W-P)L \times B} = D$$

$$\frac{d^2 \times T \times C}{D \times L \times B} + P = W$$

$$W - \frac{d^2 \times T \times C}{D \times L \times B} = P$$

$$\frac{d^2 \times T \times C}{(W-P)D \times B} = L.$$

Compressive Stress on Iron Tube Plates.

The working pressure on iron tube plates should not exceed that found by the following formula:—

D = Least horizontal distance between the centres of tubes in inches.
d = Inside diameter of the ordinary tubes in inches.
T = Thickness of the tube plate in inches.
W = Extreme width of combustion box in inches, from the front of tube plate to back of fire box, or the distance between the combustion box tube plates when the boiler is double ended and the box common to the furnaces at both ends.
C = 15000.
B = Working pressure per square inch in lbs.

$$\frac{(D-d)T \times C}{W \times D} = B$$

$$\frac{B \times W \times D}{(D-d) \times C} = T$$

$$\frac{(D-d)T \times C}{B \times D} = W$$

$$\frac{C \times d \times T}{CT - BW} = D$$

$$\frac{D(CT - BW)}{CT} = d.$$

If the iron for tube plates be not of good quality they are very liable to crack, more particularly the tube plate in the combustion chamber, and the tube plate opposite the furnace when the tubes directly face it. Scale and dirt being particularly liable to accumulate on the plate around the end of the tubes, it is therefore more liable to be affected by the intense heat to which the plate is subjected. The plate, after the tubes are expanded or drifted, has a considerable amount of strain on it, and therefore should be of a very ductile and homogeneous quality.

Uptakes (Iron).

The strength of iron uptakes of vertical boilers and others of this type, should be considerably in excess of that required for ordinary superheaters, subject to external pressure.

Bowling rings or flanged joints add to the strength and allow for expansion; T or L hoops riveted round, although not so desirable, may be employed to increase the resistance of the tubes against collapse. The use of Bowling rings or flanged joints with a moderate thickness of plate is very much better than very thick plating.

When flaming coal is used, great care is required and extra strength *absolutely necessary in the* uptakes; the tensile strength of the iron

plates when heated to the degree which they sometimes are, is frequently only about 9000 lbs. per square inch, or less than about one-fifth of what it is when cold.

Hemispherical Ends (Iron).

Hemispherical ends made of wrought iron plates, when subjected to internal pressure, should not have a pressure exceeding double the pressure that is suitable for a cylinder of the same diameter and thickness. The working pressure is found by the formula :—

$$\frac{4T \times 40000 \times r}{D \times F} = B.$$

D being equal to the diameter, F to the suitable factor of safety, T to the thickness of the plate in inches, % to the calculated percentage strength of joint, r to the percentage divided by 100, and 40000 the tensile strength per square inch in lbs. of the iron plate, B equalling the working pressure. Generally it is advisable to make the ends of the same thickness as the cylindrical part.

$$\frac{B \times D \times F}{4 \times 40000 \times r} = T$$

$$\frac{40000 \times r \times 4T}{B \times D} = F$$

$$\frac{D \times F \times B}{4 \times T \times 40000} = r.$$

Dished Ends (Iron).

Dished ends should be stayed. If they be theoretically equal to the pressure needed, when considered as portions of spheres; the iron stays, when solid, not welded or worked in the fire, should not have a stress on them exceeding 14000 lbs. per square inch of net section, but the stress should not exceed 10000 lbs. when the stays have been welded or worked in the fire. If they are not theoretically equal to the pressure needed, they should be stayed the same as flat surfaces.

Welded Seams (Iron).

Welding seams in the shells, receivers or domes of iron boilers is not the most reliable method of construction, there being at the best a certain amount of uncertainty about such seams, as they have been known to give out when least expected. They are not worth more than from about 60 to 70 per cent. of the solid plate, and may be worth much less. The plate near the weld is injured, due to excessive heating, &c., during the process of welding, and has been proved to be very brittle, and has broken even at less than one-fourth of what it was considered

to be worth. 9000 lbs. per square inch is a low strength for the shell plate of a cylindrical boiler, and welded seams have given way at that stress. Heating the plate, &c., as is done when welding, causes portions of it to be in tension, and portions in compression, and the stresses set up are such as to cause it to fracture at a low tensile stress, or when vibration takes place. Although these great drawbacks as to welded iron seams exist, and welding is not recommended, cases may *occasionally* arise when an Engineer Inspector may not always feel justified in refusing to accept them, but in no case should more than from about 60 to 70 per cent. as a maximum of the strength of the solid plate be allowed, as that is the utmost value when the iron is very good, and the workmanship and method of welding the best that they can be.

When seams are welded, if the whole plate were heated and allowed to cool gradually, it would remove *some* of the evil, but that is not practicable with large shells, yet the joint and about 12 inches on each side may be heated and allowed to cool gradually. In smaller cylindrical articles, such as domes, they should when welded always be heated carefully all over and allowed to cool gradually; although this may not be so necessary in the case of furnaces, as they have to bear a compressive strain, yet it is desirable that the injurious effects of welding should be removed as much as possible by annealing.

STEEL BOILERS.

There being many descriptions or qualities of steel, before it is used in the construction of boilers, it is essential that the general quality of the particular steel to be used should have been proved suitable for the purpose; the quality of iron varies very considerably, but the variations are small compared with the variations in steel. Iron is frequently used without testing, although such indiscriminate use of iron is not recommended, but to use steel without proving its quality, is fraught with very great danger; however, if proper precautions be taken to prove that the quality is suitable, and all good makers are quite willing to prove the quality of their steel, it may with much advantage be employed in the construction of boilers, provided that attention be paid to the following :—

Testing and Marking by Makers.

One or more pieces cut from each plate and bar should be tested for tensile strength and elongation, and both results stamped on the plate or bar, when practicable, where they can be easily seen when the boiler is constructed; this should be done by the steel maker, but if by accident it be not done at the steel works, it should be done at the boiler works before the plates are accepted.

Testing and Marking, &c., by Inspectors.

It is very desirable that the Engineer Inspector responsible for the boiler should witness the whole of the tests, but if unable to do so he should select at least one in four of the plates, either at the steel works or in the boiler maker's works, and witness the testing of at least one strip cut from each selected plate ; he should also see that the plates which the maker tests are all properly marked, so that he can afterwards distinguish those he saw tested from those which were tested by the maker, but not in his presence, and so be in a position to know the quality of all the plates. The foregoing as to testing and marking plates also applies to bars for stays and rivets, except that only one in twenty need be tested when not over 1 inch diameter, one in twelve when not over $1\frac{1}{2}$ inch, and one in eight when exceeding $1\frac{1}{2}$ inch.

There should be at least one test piece cut off each end of plates that are 15 feet long or over, and one from each corner when over 20 feet long; if the results of testing are within the prescribed limits, the mean of the results of the tests of the pieces off each end should be stamped on the plate. In all cases where the results of the first tests are unsatisfactory, duplicate and triplicate tests should be made, and if these fulfil *the conditions, the plates* may be considered suitable.

Working Stress not Over Iron.

If for the plates from which the Inspector selects the foregoing proportions, a greater working stress is wished than is approved of for iron, tests for tensile strength and elongation should be made, and those for which no allowance over iron is wished may be tested for resistance to bending, if preferred. In the latter case, the tensile strength and elongation stamped on each plate by the maker should be noted by the Inspector, as well as the results of the bending tests. In *all* cases some bending tests should be made on strips both tempered and otherwise.

Test Strips or Pieces.

The breadth of test strips for tensile strength should be about 2 inches, and the elongation taken in a length of 10 inches should be about 25 per cent., but never less than 20 per cent. The test strips should be carefully prepared and measured. Sufficient should be cut off the edges of the plates by a planing or shaping machine to remove the injury done by shearing. The test pieces from bars may be prepared in a lathe or by a machine, and should never be heated and worked down under the hammer.

Bending Tests.

The bending tests for plates *not* exposed to flame should be made with strips in their normal condition, and occasionally also some tempering tests should be made; but strips cut from furnace and combustion box plates, &c., should be heated to a cherry-red, then plunged into water of about 80° F., and kept there until of the same temperature as the water, and then bent. The bending strips should not be less than 2 inches broad and 10 inches long, and they should be bent until they break, or until the sides are parallel at a distance from each other of not more than three times the thickness of the plate, which test they should bear without cracking.

Tensile Strength, &c.—Shell Plates.

The tensile strength of the plates *not* exposed to flame should be about 28 tons, and should not exceed 32 tons per square inch of section, and 28 or 29 tons is a fair stress to use in the calculations for the working pressure of cylindrical shells, if the plates comply with all the conditions which have been previously stated; but when lightness is of *much* consequence, if the tensile strength is not less than 27 tons, 29 tons may be used in calculating the working pressure; if 28 tons tensile strength, 30 tons may be used; if 29 tons tensile strength, 31 tons may be used; and if 30 tons tensile strength, 32 tons may be used in calculating the working pressure for cylindrical shells. When steel having a higher tensile strength than that named here has been proved suitable

for boilers, the weight of the boiler may be further reduced, but it is to the steel maker that we must look to accomplish this; but taking into account the effect of corrosion, &c., it is a question which should be well considered before approval is given to the lightening of the scantlings, for, except in a few cases, such will not be economical to shipowners and owners of boilers. When a high tensile strength is aimed at, care should be taken that the ductility and reliability of the plate are not sacrificed.

Tensile Strength, &c.—Furnace and Flanging Plates, &c.

The tensile strength of furnace, flanging, and combustion box plates may range from 26 to 30 tons per square inch, and should have an elongation, taken in 10 inches, of about 25 per cent., and never less than 20 per cent.; it is very desirable that the elongation should not be less than 25 per cent.

Bars, Stays—Tensile Strength, &c.

Bars for stays should be tested. Solid steel screwed stays, which have not been welded or otherwise worked after heating, may have a working stress of 9000 lbs. per square inch of net section, provided the tensile strength be from 27 to 32 tons per square inch, and the elongation in 10 inches about 25 per cent., and not less than 20 per cent.; but if a stress of only about 7000 lbs. per square inch of net section be adopted, it will prevent the necessity of renewing the stays at such an early period in the life of the boiler, and so be more economical, except where a slight saving in weight is of great importance. Steel stays which have been welded or worked in the fire have been found to be unreliable; therefore, they should *not* be used.

Rivets—Tensile Strength, &c.

Bars from which rivets are made should be tested, and generally a few rivets of each size should also be selected, and should be turned and tested for tensile strength, &c. The bars for rivets should be from 26 tons to 30 tons per square inch, and the elongation in 10 inches not less than 25 per cent., and the contraction of area about 60 per cent. The tensile strength of rivets may be from 26 to 32 tons per square inch, and the contraction of area about 60 per cent.

The rivet before being tested should be turned, and the length of the parallel part should be 2·5 times the diameter of the turned part.

Recording the Results of Tests.

The results of all the tests of the plates, bars, rivets, &c., should be *tabulated by the Engineer* Inspector who witnesses the tests, and *carefully preserved* for reference.

Annealing.

s that are punched, flanged, or locally heated should be care-
led after being so treated. The plates should be heated all
operation in a properly constructed furnace, and then allowed
dually.

Local Heating.

ating of the plates is very objectionable, and should be
many plates have failed from having been so treated. If
attended to, serious accidents are likely to result.

Welded Plates.

tes which have been welded should not be used when sub-
tensile stress, and those welded and subject to a compres-
should be efficiently annealed in a properly constructed

Drilling in Place.

t holes in the furnaces and longitudinal seams of cylin-
ls should be drilled after bending. If proper machines be
not only better to drill in place, but is also cheaper than

Punching and Boring.

g plates and afterwards boring them is not recommended; but
one care should be taken that a sufficient quantity is bored out
move as far as possible the very injurious effect of punching.
l that when a half inch plate is punched nine-sixteenths inch
s to be bored out to fully twelve-sixteenths, and an inch
hed one inch and one-sixteenth requires to be bored out to
and five-sixteenths to remove the pernicious effect of the
the plates, and consequently plates of greater thickness
have more bored out so as to remove the injurious effects of
There is nothing gained by punching and afterwards
d there is also more or less risk of the injury done by the
t being removed, and therefore such a barbarous tool as a
uld never be used to steel plates.

Punching and Annealing.

g plates and afterwards annealing them is decidedly an
ble method, *and before it is done the special assent of the
nspector should be obtained*; if he assents, it is essential

that he should satisfy himself that the annealing is done properly and in a properly constructed furnace. Punching the holes before the plates are bent is very objectionable, and generally this cannot be conveniently done afterwards, and as all punching should be avoided it cannot be too strongly urged upon those interested that drilling in place is the only really satisfactory method of perforating the plates. There can seldom or never be any good reason for punching, or punching and afterwards boring, and there are many good reasons why this should not be done. There are several very suitable drilling machines, which are used by all first class boiler makers and found to be of great advantage, and the purchaser of boilers and all interested will be acting with prudence if they object to such inferior work as punching; they can get first class work for about the same price, and will be less likely to come under the Employers' Liability Act from having used, to say the least, very indifferently constructed boilers.

Riveted Joints for Cylindrical Shells, Receivers, Domes, &c. (Steel).

If the plates for cylindrical shells, receivers, domes, &c., and the rivets, comply with the foregoing conditions, the percentage of strength of any joint or other particulars of the joint may be found by the following formulæ:—

p = Pitch of rivets in inches.
d = Diameter of rivets in inches.
A = Area of one rivet in square inches.
n = Number of rivets in one pitch (greatest pitch).
$\%$ = Percentage of plate left between rivets in greatest pitch.
$\%_1$ = Percentage of rivet section as compared with solid plate.
$\%_2$ = Percentage of combined plate and rivet section when the number of rivets in the second row is twice that in the outer row.
c = 1 for lap or single butt strap joints.
c = 1·75 for double butt strap joints.
T = Thickness of plate in inches.

To find the percentage strength of any given joint—

$$\frac{100(p-d)}{p} = \% \quad . \quad . \quad . \quad (1)$$

$$\frac{100 \times 23 \times \mathrm{A} \times n \times c}{28 \times p \times \mathrm{T}} = \%_1 \quad . \quad . \quad . \quad (2)$$

When the number of rivets in the second row is twice that in the outer row—

$$\frac{100(p-2d)}{p} + \frac{\%_1}{n} = \%_2 \quad . \quad . \quad . \quad (3)$$

of the values so found is the percentage strength of the

ormula (3) will seldom be found necessary.
utt strapped joints $\frac{\%}{\%}$ or $\frac{\%}{\%_1}$ is always less than $\%_2$ so long
r of the rivets is not less than the thickness of the plate,
nts when the diameter is not less than $\frac{T}{\cdot 4515}$.
hen p, c, n, T are known so that $\frac{\%}{\%}$ may be equal to $\%_1$ —

$$\sqrt{\frac{\cdot 775\times T}{n\times c}\left\{\frac{\cdot 775\times T}{n\times c}+2p\right\}}-\frac{\cdot 775\times T}{n\times c} = d \quad . \quad . \quad (4)$$

hen d, n, c, T are known so that $\frac{\%}{\%}$ may be equal to $\%_1$—

$$\frac{23\times A\times n\times c}{28\times T}+d = p \quad . \quad . \quad . \quad (5)$$

and p when n, c, T and the required percentages are

$$\frac{1\cdot 55\times\%\times T}{(100-\%)\times n\times c} = d \quad . \quad . \quad . \quad (6)$$

$$\frac{100\times 1\cdot 55\times\%\times T}{(100-\%)^2\times n\times c} = p \quad . \quad . \quad . \quad (7)$$

Steel Plates and Iron Rivets.

ts be used in steel plates; to find the particulars of any
going formulæ should be modified as follows:—
s (2) and (5) substitute $^8/_{13}$ for $^{23}/_{28}$, in equation (4)
)345 for ·775, and in equations (6) and (7) substitute
.

Diagonal Pitches, &c.

itches, thickness of butt straps, and minimum diameter
ound by the formulæ previously given for iron boilers.

sures on Cylindrical Shells, &c. (Steel).

rmining the working pressure to be allowed for cylindrical
rs, domes, &c., the smallest of the percentages, as found
ing formulæ (1), (2), or (3), should be used as the per-
gth of the joint, and the nominal factor of safety should
an that found from the table of additions to be made to
s given for iron boilers.
e *and other particulars* may be found by the following

T = Thickness of plate in inches.
D = Inside diameter of boiler in inches.
F = Factor of safety.
r = Lowest of the percentages %, $\%_1$, or $\%_2$ divided by 100.
B = Working pressure per square inch in lbs.

$$* \quad \frac{62720 \times r \times 2T}{D \times F} = B$$

$$* \quad \frac{B \times D \times F}{62720 \times 2 \times r} = T$$

$$* \quad \frac{62720 \times r \times 2T}{B \times F} = D$$

$$* \quad \frac{62720 \times r \times 2T}{D \times B} = F$$

$$* \quad \frac{B \times D \times F}{62720 \times 2T} = r.$$

* If the minimum tensile strength of the shell plates be such that a higher stress than 28 tons may be allowed, the constant 62720 should be modified accordingly. If 29 tons be used, it becomes 64960; if 30 tons, 67200; if 31 tons, 69440; and if 32 tons, 71680.

Curved Ends of Cylindrical Boilers (Steel).

The constant given in the previous remarks on iron boilers for curved ends may be increased about one-third, or may be 13000, thus:—

$$\frac{13000 \times r \times T}{R} = B,$$

r being equal to the percentage of plate section (%) divided by 100, T to the thickness of tube plate in inches, R to the radius of curved end in inches, and B to the boiler pressure per square inch in lbs.

If the percentage strength of the horizontal seam above the tubes be less than the percentage strength of the plate left between the tubes, such lesser percentage should be used in calculating the working pressure; and if the plate above the tube plate be of less thickness than the tube plate, its thickness should be used in the formula—that is, the smallest of the products $r \times T$ should be used.

Plates for Furnaces, Combustion Boxes, &c. (Steel).

If the flanging plates and those exposed to flame comply with the conditions stated in the preceding paragraphs relating to such plates, the *constants in the rules for* iron boilers, which precede these remarks on *steel boilers, may be increased* as follows:—

Constants for Furnaces (Steel).

appropriate constants for plain iron furnaces may have 10 per added, or—

$$\frac{1{\cdot}1 \times C \times T^2}{(L+1) \times D} = B,$$

ng the constant applicable to the circumstance of the case or d of construction, T the thickness of plate in inches, L the length furnace in feet, D the outside diameter of the furnace in inches, B the working pressure per square inch in lbs. See Tables 162 to 174.

working pressure should not exceed that found by the formula—

$$\frac{8800 \times T}{D} = B.$$

Vertical Furnaces or Fire Boxes (Steel).

the case of upright fire boxes of donkey or similar boilers, when ecrease in diameter is at least one inch for every foot of height, 10 nt. should be deducted from the constants applicable for horizontal ces with similar descriptions of seams or joints. When the ase in diameter is less than one inch per foot of height, a greater tion than 10 per cent. should be made. See Tables Nos. 162 to and notes preceding the Tables.

Curved Tops of Combustion Boxes (Steel).

e constant suitable for curved tops of iron combustion boxes, as mined by reference to the remarks on *iron* boilers preceding this, e increased by 10 per cent. The remarks on T bars for stiffening, he radius of curvature, should be attended to.

Corrugated Furnaces (Steel).

en furnaces are corrugated and machine made, and practically circles, the working pressure may be found by the following la,* provided that the plain parts at the ends do not exceed es in length, and that the plates are not less than $\frac{5}{16}$ inch thick. ables Nos. 176 and 177.

ovided that the pitch of the corrugations is not more than 6 inches, and the including thickness of plate, not less than 2 inches, or the maximum e diameter not less than 4 inches more than the minimum inside diameter; the depth of the corrugations is less, the pitches should be proportionally d.

T = Thickness of plate in inches.
D = Mean diameter of furnace in inches.
C = 12500.
B = Working pressure per square inch in lbs.

$$\frac{C \times T}{D} = B$$

$$\frac{C \times T}{B} = D$$

$$\frac{B \times D}{C} = T.$$

If the furnace be riveted in two or more lengths, it may be advisable to reduce the constant.

Constants for Flat Surfaces (Steel).

When flat surfaces are supported by stays, screwed into the plate and riveted over so as to form a substantial head, 10 per cent. may be added to the appropriate constant for iron plates; or—

$$\frac{1{\cdot}1 \times C \times (t+1)^2}{S-6} = B,$$

C being equal to the constant according to the circumstances of the case, t the thickness of the plate in sixteenths of an inch, S the surface supported in square inches, and B working pressure per square inch in lbs.

When flat surfaces are supported by stays screwed into the plate and nutted, or when the stays are nutted in the steam space, 25 per cent. may be added to the appropriate constant for iron plates, and also when the plates are stiffened by riveted washers or doubling strips and supported by nutted stays, thus :—

$$\frac{1{\cdot}25 \times C \times (t+1)^2}{S-6} = B.$$

The pressures for small surfaces and pitches should, however, be taken from the Tables Nos. 81 to 109.

Girders for Flat Surfaces (Steel).

The constants applicable for solid wrought iron girders, as given in the preceding remarks on iron boilers, may be increased 10 per cent. when mild steel girders, made of rolled plates and not worked in the fire, are used, or,

$$\frac{1{\cdot}1 \times C \times d^2 \times T}{(W-P)D \times L} = B,$$

ng the constant applicable to the number of bolts fitted, d of girder in inches, T thickness of girder in inches, W width nbustion box in inches, P pitch of supporting bolts in inches, tance between the girders from centre to centre in inches, L length der in feet, and B working pressure per square inch in lbs.

› stress on the supporting bolts should not exceed that stated usly in the section on Steel, in clause "Bar Stays," page 42, working pressure can be found in Tables No. 110 *et seq.*, and orking pressure for the plate can be found by the formula in this n on Steel, clause "Constants for Flat Surfaces," or may be from Tables No. 81 *et seq.*; but when the pitches are small the ires from the tables should always be used, and not that arrived the use of the formula.

Crushing Stress on Tube Plates (Steel).

e plates should not have a greater working pressure on them that found by the following formula:—

= Least horizontal distance between the centres of tubes in inches.
= Inside diameter of the ordinary tubes in inches.
= Thickness of the tube plate in inches.
= Extreme width of combustion box in inches, from the front of tube plate to back of fire box, or the distance between the combustion box tube plates, when the boiler is double ended and the box common to the furnaces at both ends.
= 20000.
= Working pressure per square inch in lbs.

$$\frac{(D-d)T \times C}{W \times D} = B$$

$$\frac{B \times W \times D}{(D-d) \times C} = T$$

$$\frac{(D-d)T \times C}{B \times D} = W$$

$$\frac{C \times d \times T}{CT - BW} = D$$

$$\frac{D(CT-BW)}{CT} = d$$

Superheaters and Uptakes (Steel).

lough steel may not be considered so suitable for superheaters e unshielded uptakes of boilers, including those of ordinary l donkey boilers, as first-class iron, Engineer Inspectors may *to its being used; but* when they do so the actual strength of the

D

BOILERS, GENERAL REMARKS.

NEUTRAL PARTS OF SHELLS, MANHOLES, STEAM PIPES, FITTINGS, TESTING, EXAMINATION, LIFTING FOR INSPECTION, SETTING, &c.

Neutral Parts of Shells.

It is essential that the neutral part of boiler shells under steam domes should be efficiently stiffened and stayed, and this may be done by stays from the shell to the top of dome, or gusset stays attached to the shell and sides of dome. If by stays to the top of the dome, large washers well bedded should be fitted under the nuts inside the shell of the boiler, or T bars may be riveted circumferentially to the top of the shell of the boiler, and the stays attached to the T bars. The size of the stays should not be less than those for dished ends.

Manholes, Mudholes, and Openings.

The openings in the shells of cylindrical boilers should have their *shorter* axis placed longitudinally.

All manholes, mudholes, and other openings should be strengthened and stiffened with compensating rings of at least the same effective sectional area as the part of the plate cut out. In no case should a plate ring be less in thickness than the plate to which it is attached. A flanged plate ring riveted on inside the manhole or mudhole opening makes a very good job; the edge should be faced, then a good joint can be made with the door. A ring of *iron* angle or T bar riveted on the outside with the weld placed at the larger axis makes an efficient job, but welded steel rings or plates should not be used round openings.

Manhole and Mudhole Doors.

The doors should always be fitted inside the boiler, if practicable. The bolts should be screwed into the door, with a shoulder or collar, with a nut inside, and the ends of the bolts riveted over. There should be four bolts in large doors which are *not* embossed, but two bolts are generally sufficient in large embossed doors, and one in very small ones. The size of bolts must depend on the circumstances of each case. Except in the case of very small mudhole or sight doors, the diameter of the bolts should not be less than one and one quarter inch. The doors should fit well, and so prevent the material used for making the joints getting blown out. They should be made from wrought iron or steel plate from about ·4 to 1 inch thick, according to size and pressure; the doubling plate should be about one half the thickness of the plate to which it is riveted. Embossed steel doors are recommended.

Cast manhole or mudhole doors should not be fitted.

Cross Bars for Manhole and Mudhole Doors.

Manhole doors should not have less than two cross bars, nor should mudhole doors unless they be very small.

The cross bars should always be forged out of the solid, and if the les are punched or drifted when hot, proper dies, &c., should be used, t drilling the holes makes a first class job. The feet or ends should l well on the strengthening ring round the opening, or, if the ring is iide, on the part of the shell to which the ring is riveted.

Openings in Boiler Shells, Superheaters, Steam Receivers and Domes.

All holes cut for mountings should have wrought iron or steel plates l rings riveted round the openings, and the plate rings at the thinnest t should be at least as thick as the plate they are riveted on, with e and flat surfaces on the top of the rings; this not only compensates the part cut out, but enables a steam-tight joint to be *easily* made, re particularly in the case of cylindrical shells. The net section of ring should not be less than the part cut out—in general it will be nd better to make it greater; it is also advisable to have the diameter the ring larger than the diameter of the flange which is to be ited to it. In cases where the tube plate is carried down to stiffen openings over the furnaces, and mountings are fitted on such parts, gs are not necessary, and a true surface can easily be made for the iges of the mountings or fittings.

Steam Stop Valves or Cocks.

Each boiler should be fitted with a stop valve, and it should be inected directly to the boiler, the neck of the casting being as rt as practicable. When two or more boilers are connected with steam receiver or superheater, a stop valve should be fitted between h boiler and the steam receiver or superheater. This is necessary ivoid the failure of all the boilers through the failure of one.

When the boiler is very small, a cock attached directly to the boiler y answer the purpose of a stop valve, but the neck of the cock uld be as short as is practicable, and should be attached to the ler by a flange.

When the stop valve cannot be attached directly to the boiler, a rt length of wrought iron pipe, made of the best quality of iron te, should be riveted to the boiler, and the stop valve attached to pipe. In such cases the pipe should be made considerably thicker n required for the pressure when new, so as to allow for corrosion, t will waste much more rapidly than the shell of the boiler.

t is desirable that arrangements should be made so that the stop ve can be shut without going on the boiler, and when practicable it uld be so arranged for marine boilers that it can be shut from the k.

Expansion Joints for Steam Pipes.

Expansion *joints should be fitted* to steam pipes, and there should *fixed collar with bolts fitted* so as to prevent the end of the pipe

Guards for Blow-off Cocks.

There should be guards fitted to all blow-off cocks, so that the spanner or handle cannot be taken off unless the cock be shut; this is *essential* when the cock is below the plates, or not always distinctly in sight, and is desirable in whatever position the cock may be placed. In any case where the cock is always visible, and the arrangement is such that there is no guard fitted, the spanner or handle should be securely fixed to the plug of the cock, and not merely shrunk on. On board ship, in addition to the cock directly on the boiler, there should be one placed directly on the skin of the vessel, or on the side of the Kingston valve; and the same arrangement of spanners, with guards, &c., should be fitted as in the case of the cock directly on the boiler. Kingston valves are not now generally fitted.

Scum or Brine Cocks.

The scum or brine cock or valve should be attached directly to the boiler, and the handle of the cock should be securely fixed to the plug, not merely shrunk on; and if it be so placed that it is not always visible and easy of access, there should be a guard fitted so that the handle or spanner cannot be taken off when the cock is open.

Feed Cocks or Valves.

There should be separate feed arrangements fitted in addition to and also unconnected with the main feed pipes and valves. In the case of very small boilers, an efficient hand pump, by which the boilers can be fed when steam is up, may be in some cases found sufficient, but it should not be considered so unless properly tried; it is desirable that a donkey engine be fitted for working the additional feeding arrangements which are separate and independent of the main feeds.

It is most desirable that there should be a non-return valve fitted between the feed cock or valve and feed pipe, and so arranged that when the feed cock or valve is shut, the non-return valve can be taken out and any defects remedied; and when there is a separate inlet for each feed, which is most desirable, one can be at work while the other feed is shut off, and the non-return valve is being put right.

There should be a separate feed cock or feed valve to each boiler; but when this is not the case, there should be a non-return valve, with an adjusting screw on each boiler between the single feed cock or feed valve and the boiler; one cock or valve to feed more than one boiler is impracticable.

Necks of Valves and Cocks.

The necks of all valves and cocks should be as short as practicable, but when they are obliged to be of an unusual length they should be well and efficiently bracketed, and the flanges thicker, and an extra *number of bolts or studs* fitted, for attaching them to the boiler, or the *bolts or studs should be* considerably larger.

Testing Boilers by Hydraulic Pressure.

All new boilers should be tested by hydraulic pressure to twice the rking pressure, but not above that; the working pressure should ly be fixed after the boiler has been carefully examined inside and side, the method of construction considered, and the working ssure should not exceed that found by the formulæ preceding this. the test be not satisfactory, and any defects are observed, they should made good, and the boiler again subjected to twice the working ssure.

Steam chests, receivers, domes, and superheaters should be tested the same manner, and the pressure fixed in the same way, care being en that they are, by the preceding rules applicable to them, fit for same pressure as the boiler.

Testing and Examining Small Boilers, &c.

If any boiler be too small to allow the Inspector to get inside, the rking pressure should not be fixed until the case has had careful coneration, and the boiler should be tested by hydraulic pressure at st every twelve months. If it be only stays which prevent the gineer Inspector getting in, they should be removed; but it is essen- that he should, before finally approving of the efficiency of the ler, see that they are properly replaced.

Examination of Boilers.

Previous to finally examining any boiler, with a view to fixing the rking pressure, it should be thoroughly cleaned inside and out, and hould be cool enough to enable a thorough examination to be made, l until it has been thoroughly cleaned and carefully examined the king pressure should not be fixed; all plates the thickness of which n any way doubtful should be drilled, so that their actual thickness ascertained. Superheater plates, steam space plates, and those ler and in proximity to the bridges, should be frequently drilled, as y are specially liable to get thin.

Baffle or Shield Plates.

Baffle or shield plates should be fitted to the flat ends of boilers, as as the steam space extends, also to the ends of superheaters, where osed to the hot gases, &c.; in the uptake, all plates on which the ect impact of heat or flame acts, being very liable to be injured ess water be in contact with them on the one side, should be ciently protected by baffle or shield plates.

Lifting Boilers for Inspection.

When *all the outside of any boiler* cannot be seen, it should be lifted *n its seat and thoroughly* inspected *at least* once in every four years.

It may be advisable to reduce the pressure before the expiration of four years, if the boiler be not lifted, so as to enable the Inspector to satisfy himself as to its efficiency for the pressure.

If for special reasons it is not wished to lift a boiler, the circumstances of the case should be *specially* considered, so that the efficiency of the boiler for a short time and for the pressure wished may be decided.

When any boiler is lifted, all temporary patches, if any, should be removed and permanent ones riveted on.

All boilers when lifted for inspection or for other reasons should be tested by hydraulic pressure to twice what they are intended to be worked at, after all the repairs are made and before they are reset. A record should be made by the Inspector of the test—as to when made, the condition of the boiler, and what repairs, if any, have been made, and by whom.

Setting and Fixing Boilers.

Before a boiler is set the outside of the bottom should be thoroughly scraped and well rubbed with sandstone, then well brushed with a hard brush and painted with two coats of red lead, which should be well ground and mixed; each coat of paint should be allowed to harden thoroughly, and when the last coat is well hardened, a coat of coal tar should be applied, and when it is quite hard the boiler can be set or fixed. In the case of land boilers set in brick-work, it is necessary that all lime be kept away from the boiler plates; it is also very desirable that the boiler be bedded in red lead, as when this is done the plates do not corrode, the cost will ultimately be more than amply repaid, and the chance of explosion greatly lessened. If the boiler be on board ship, care should be taken that the boiler be set so that there is as little chance as possible of bilge water getting to the plates.

Want of such precautions shortens the life of a boiler, besides frequently contributing to that which is worse, viz., an explosion.

RIVETING IRON AND STEEL.

Joints of Special Construction.

Formulæ have been given in a former part of the book, for ascertaining the proportions and finding the value of riveted joints as usually de, but by what follows the value of joints of special construction y be determined, such as joints in which the rivets are not all of the ne diameter, or in the case of joints where some of the rivets are in gle shear and some in double shear, or where the rivets are of ferent diameters, as well as some of them being in single shear and ne in double shear.

The formulæ which follow are applicable when the rivets in any one v are of the same diameter, although the diameters may differ in each v.

The formulæ are also applicable to ordinary joints, although not so ivenient for use when applied to such joints as the formulæ preusly given for ordinary riveting.

p_1 = Pitch of rivets in inches in outer row.
p_2 = Pitch of rivets in inches in second row.
p_3 = Pitch of rivets in inches in third row.
p_4 = Pitch of rivets in inches in fourth row.
d_1 = Diameter of rivets in inches in outer row.
d_2 = Diameter of rivets in inches in second row.
d_3 = Diameter of rivets in inches in third row.
d_4 = Diameter of rivets in inches in fourth row.
A_1 = Area of one rivet in square inches in outer row.
A_2 = Area of one rivet in square inches in second row.
A_3 = Area of one rivet in square inches in third row.
A_4 = Area of one rivet in square inches in fourth row.
$\%_{P1}$ = Percentage of plate left between rivets in outer row.
$\%_{P2}$ = Percentage of plate left between rivets in second row.
$\%_{P3}$ = Percentage of plate left between rivets in third row.
$\%_{P4}$ = Percentage of plate left between rivets in fourth row.
$\%_{R1}$ = Percentage of rivet section in outer row as compared with solid plate.
$\%_{R2}$ = Percentage of rivet section in second row as compared with solid plate.
$\%_{R3}$ = Percentage of rivet section in third row as compared with solid plate.
$\%_{R4}$ = Percentage of rivet section in fourth row as compared with solid plate.
C = 1 when the rivets are in single shear.
C = 1·75 *when the rivets* are in double shear.
T = *Thickness of plate,* in inches.

$$\frac{100(p_1 - d_1)}{p_1} = \%_{P_1}$$

$$\frac{100(p_2 - d_2)}{p_2} = \%_{P_2}$$

$$\frac{100(p_3 - d_3)}{p_3} = \%_{P_3}$$

$$\frac{100(p_4 - d_4)}{p_4} = \%_{P_4}$$

$$* \frac{100 \times A_1 \times C}{p_1 \times T} = \%_{R_1}$$

$$* \frac{100 \times A_2 \times C}{p_2 \times T} = \%_{R_2}$$

$$* \frac{100 \times A_3 \times C}{p_3 \times T} = \%_{R_3}$$

$$* \frac{100 \times A_4 \times C}{p_4 \times T} = \%_{R_4}$$

Having found the percentages by the foregoing formulæ, the percentage value of the joint is determined as follows:—

Value at outer row	=	$\%_{P_1}$.
Value at second row	=	$\%_{P_2} + \%_{R_1}$.
Value at third row	=	$\%_{P_3} + \%_{R_1} + \%_{R_2}$.
Value at fourth row	=	$\%_{P_4} + \%_{R_1} + \%_{R_2} + \%_{R_3}$.
Value of rivets	=	$\%_{R_1} + \%_{R_2} + \%_{R_3} + \%_{R_4}$.

The lowest of the values so found is the percentage value of the joint.

The working pressure is found by the formula

$$\dagger \frac{47000 \times r \times 2T}{D \times F} = B,$$

B being the working pressure, T the thickness of the plate, r the percentage applicable divided by 100, D the diameter of the boiler, and F the nominal factor of safety. See formula for iron boilers, page 24.

Diagonal Pitches.

The value of the metal in the diagonal pitch is only about five-sixths of what it is in the horizontal pitch, therefore the net section in the diagonal pitch should be one-fifth greater than it is in the horizontal pitch, or in the part of the horizontal pitch to which it is required to be equivalent in strength.

* If steel plates and steel rivets, multiply by $\frac{23}{28}$.

† If steel plates, substitute 62720 for 47000; if 28 tons steel, but for any other *tensile strength the number* which it represents in lbs. per square inch should be *used.*

Thickness of Butt Straps.

The *minimum* thickness of butt straps is found by the following formulæ :—

T = Thickness of plate in inches.
T_1 = Thickness of each butt strap in inches (minimum).

$$\frac{5\ (\text{Plate percentage at outer row}) \times T}{8\ (\text{Plate percentage at inner row})} = T_1 \text{ Double butt straps ;}$$

$$\frac{9\ (\text{Plate percentage of outer row}) \times T}{8\ (\text{Plate percentage at inner row})} = T_1 \text{ Single butt straps.}$$

FLAT SURFACES.

PRESSURES, PITCHES, AND SURFACES.

Iron Plates.

In the Tables numbered from 2 to 30, which follow these notes and remarks, Pitches are given from about 21 inches to 3·5 inches, and surfaces from about 440 square inches to 12 square inches, with the thickness of plates and Pressures suitable for the different Pitches and Surfaces, according to the particular conditions under which the Pressures, Pitches, and Surfaces are applicable. The Pressures range from 5 lbs. to 160 lbs. per square inch. The thickness of the plates ranges from $\frac{1}{4}$ to $1\frac{1}{8}$ inch, each Table advancing by $\frac{1}{32}$ of an inch.

The following notes and remarks will facilitate the use of the Tables:—

The distinguishing letters over the different Columns in each Table refer to the conditions under which the Pitches and Surfaces are suitable for the Working Pressure opposite the particular Pitch and Surface, when the plates are of the thickness given at the head of the Table; and, consequently, opposite the particular Pressures will be found the Pitches and Surfaces suitable for the Working Pressure for the thickness of plate at the head of the Table.

The following are the conditions to which each distinguishing letter in the Tables refers; they show under which distinguishing letter the Pitches and Surfaces should be looked for in the Table for the suitable thickness of plate:—

Distinguishing Letters.		Distinguishing Letters.
A.	If the plates are *not* exposed to the impact of heat or flame, and the stays are fitted with nuts and strips of at least the thickness of the plates they cover, and of a width of not less than $\frac{2}{3}$ the pitch of the stays, and the strips are properly riveted to the outside of the plates; then the maximum Working Pressure is that found opposite the Pitch or Surface in Column	A
B.	If the plates are *not* exposed to the impact of heat or flame, and the stays are fitted with nuts and washers of at least the thickness of the plates they cover, and of a diameter not less than $\frac{2}{3}$ the pitch of the stays, and the washers are properly riveted on the outside of the plates; then, the maximum Working Pressure is that found opposite the Pitch or Surface in Column	B
C.	If the plates are *not* exposed to the impact of heat or flame, and the stays are fitted with nuts and washers of at least $\frac{2}{3}$ the thickness of the plates they cover, and of a diameter of not less than three times the diameter of the stay over the thread; then the maximum Working Pressure is that found opposite the Pitch or Surface in Column . .	C

Distinguishing Letters.		Distinguishing Letters.
D.	If the plates are *not* exposed to the impact of heat or flame, and the stays are fitted with nuts only; then the maximum Working Pressure is that found opposite the Pitch or Surface in Column	D.
E.	If the plates are exposed to the impact of heat or flame, and water is in contact with the plates, and the stays are screwed into the plates, and fitted with nuts; then, the maximum Working Pressure is that found opposite the Pitch or Surface in Column	E.
F.	If the plates are *not* exposed to the impact of heat or flame, and water is in contact with the plates, and the stays are screwed into the plates, and the ends of the stays are riveted over so that substantial heads are formed; then the maximum Working Pressure is that found opposite the Pitch or Surface in Column	F.
G.	If the plates are exposed to the impact of heat or flame, and steam is in contact with the plates, and the stays are fitted with nuts and washers of at least ⅝ the thickness of the plates they cover, and of a diameter not less than three times the diameter of the stay, over the thread; then the maximum Working Pressure is that found opposite the Pitch or Surface in Column	G.
G.	If the plates are exposed to the impact of heat or flame, and water is in contact with the plates, and the stays are screwed into the plates, and the ends of the stays are riveted over so that substantial heads are formed; then the maximum Working Pressure is that found opposite the Pitch or Surface in Column	G.
H.	If the plates are exposed to the impact of heat or flame, and steam is in contact with the plates, and the stays are fitted with nuts only; then the maximum Working Pressure is that found opposite the Pitch or Surface in Column, . .	H.
I.	If the plates are exposed to impact of heat or flame, and steam is in contact with the plates, and the stays are screwed into the plates, and the ends of the stays are riveted over so as to form substantial heads; then the maximum Working Pressure is that found opposite the Pitch or Surface in Column	I.

In any case where the material or workmanship is defective, or the nuts or ends of the stays, &c., are defective, the Working Pressure should be less than that found opposite the Pitches and Surfaces, which are applicable for cases where all is first class as to material, workmanship, and condition.

The following examples will further facilitate the use of the Tables:—

(1) To find *the Working Pressure* for a given Thickness of Iron Plate *and a given Pitch or Surface*:—

If the Iron Plate be $^9/_{16}$ inch thick, the Surface 70, and Pitch 8·36 inches, and the conditions of the case make the Surface and Pitch in column E applicable; in Table No. 12, which is for $^9/_{16}$ inch Iron Plates, in column E, the surface 70 is found, and the Pitch 8·36, or say 8⅜ inches, opposite which the Pressure is 125 lbs. per square inch.

(2) To find the Pitch or Surface for a given Pressure and a given Thickness of Iron Plate :—

If the Iron Plate be $^9/_{16}$ inch thick and the Pressure 125 lbs. per square inch, and the conditions of the case make it necessary to select the Surface in column E; in Table No. 12, which is for $^9/_{16}$ inch Iron Plates, opposite 125 lbs. in Column E, is found 70, which is the Surface in square inches, the Pitch being 8·36 or, say, 8⅜ inches.

(3) To find the thickness of Iron Plate for a given Pitch or Surface and a given Pressure :—

If the Surface be 70 square inches and the Pressure 125 lbs. per square inch, and the conditions of the case make it necessary to select the Surface or Pitch in column E; then, opposite 125 lbs. Pressure, the Surface 70, and Pitch 8·36 or, say, 8⅜ inches, are found in Column E in Table No. 12, and the Thickness of the Iron Plate is found to be $^9/_{16}$ inch.

Or, if W = Working Pressure, P = Pitch, S = Surface, and T = Thickness of Iron Plate, and if A, B, C, D, E, F, G, H and I are the letters at the heads of the different Columns, indicating the Columns where the Surface applicable to the case must be looked for, then :—

(1) To find W—— when T = 1 inch, S = 408, P = 20·2, and A the distinguishing letter of Column from which the Surfaces or Pitch must be selected :—

In Table No. 26 for 1 inch Iron Plates, in Column A the Surface 408 is found, and opposite the Surface is 115 lbs., which is the Working Pressure required to be found.

(2) To find S or P—— when T = 1 inch, W = 115 lbs., and A the distinguishing letter of Column in which the Surface or Pitch must be looked for :—

In the Table No. 26 for 1 inch Iron Plates, and opposite 115 lbs. in Column A, 408 and 20·2 are found, which are the Surface and Pitch required.

(3) To find T—— when W = 115 lbs., S = 408, P = 20·2, and A the distinguishing letter of Column in which the Surface must be selected :—

As the Surface and Pitch are large, and the Pressure moderately high, the Iron Plates must be thick, and on looking down Table No. 26 for 1 inch Iron Plates, opposite 115 lbs. in Column A, are found 408 and 20·2; therefore T = 1 inch, *which is the Thickness of Iron Plates required to be found.*

in any of the foregoing examples, the Pitches only, or the Surfaces , had been under consideration instead of both Pitches and Surfaces, method of ascertaining either would have been exactly the same ne Pitches and Surfaces in each case are given opposite the Pressure er the distinguishing letter applicable to the case.

he Pitches are given in inches and decimal parts of an inch; the ar can, if required, be easily converted into vulgar fractions, and n this is done, if the decimal part is not found equal to say $^1/_{16}$ of an inch, it is advisable in practice to make the pitch to the eenth below, and such a small difference will be on the side of ty. If, for example, the Pitch in the Table be 20·2 inches, it may ractice be $20^3/_{16}$ inches, if vulgar fractions be preferred to decimals. t is desirable that flat surfaces should be supported by stays forming ares, the following Tables have been prepared for Surfaces with s pitched in squares, or nearly so. When there is a *considerable* erence in the Pitches, it is thought prudent that the Pressure uld *not* be so great; therefore, when the surface to be supported is ained by the product of two Pitches which are *considerably* different, Pressure which may be used will *not* be that opposite the Surface, may be easily found.

'or example—

If the Pitches are as 4 to 3, the Pressure opposite the Surface or product of the two Pitches may be reduced about 4 per cent.; when as 3 to 2, about 8 per cent.; when as 5 to 3, about 12 per cent.; and when as 2 to 1, the reduction of Pressure may be about 20 per cent.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{1}{4}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	20·15	406·0
10	20·15	406·0	19·52	381·0	16·00	256·0	15·19	231·0	14·35	206·0
15	16·51	272·6	16·00	256·0	13·14	172·6	12·49	156·0	11·80	139·3
20	14·35	206·0	13·91	193·5	11·44	131·0	10·88	118·5	10·29	106·0
25	12·88	166·0	12·49	156·0	10·29	106·0	9·79	96·0	9·27	86·0
30	11·80	139·3	11·44	131·0	9·45	89·3	9·00	81·0	8·52	72·6
35	10·96	120·2	10·63	113·1	8·80	77·4	8·38	70·2	7·94	63·1
40	10·29	106·0	9·98	99·7	8·27	68·5	7·89	62·2	7·48	56·0
45	9·74	94·8	9·45	89·3	7·84	61·5	7·48	56·0	7·10	50·4
50	9·27	86·0	9·00	81·0	7·48	56·0	7·14	51·0	6·78	46·0
55	...	...	...	...	7·17	51·4	6·84	46·9	6·50	42·3
60	...	...	...	...	6·90	47·6	6·59	43·5	6·27	39·3
65	...	...	...	...	6·66	44·4	6·37	40·6	6·04	36·4
70	...	...	...	...	6·45	41·7	6·17	38·1	5·78	33·4
75	...	...	...	...	6·27	39·3	5·95	35·4	5·56	30·9
80	...	...	...	...	6·09	37·1	5·73	32·8	5·36	28·7
85	...	...	...	...	5·88	34·5	5·53	30·6	5·19	26·9
90	...	...	...	...	5·69	32·3	5·36	28·7	5·04	25·4
95	...	...	...	...	5·52	30·4	5·21	27·1	4·90	24·0
100	...	...	...	...	5·36	28·7	5·07	25·7	4·78	22·8
105	...	...	...	...	5·22	27·3	4·95	24·5	4·67	21·8
110	...	...	...	...	5·10	26·0	4·83	23·3	4·57	20·8
115	...	...	...	...	4·98	24·8	4·73	22·3	4·47	20·0
120	...	...	...	...	4·88	23·8	4·63	21·5	4·39	19·3
125	...	...	...	...	4·78	22·8	4·55	20·7	4·31	18·6
130	...	...	...	...	4·69	22·0	4·47	19·9	4·24	18·0
135	...	...	...	...	4·61	21·2	4·39	19·3	4·17	17·4
140	...	...	...	...	4·53	20·5	4·32	18·7	4·11	16·9
145	...	...	...	...	4·46	19·9	4·26	18·1	4·06	16·4
150	...	...	...	...	4·39	19·3	4·20	17·6	4·00	16·0
155	...	...	...	...	4·33	18·7	4·14	17·1	3·93	15·4
160	...	...	...	...	4·27	18·2	4·09	16·7	3·87	15·0
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding *these Tables.*

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{1}{4}$ inch thick.

TABLE No. 2 *continued.*

F*		G*		H*		I*	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
18·53	343·5	17·49	306·0	16·61	276·0	13·63	186·0
13·22	174·7	12·49	156·0	11·87	141·0	9·79	96·0
10·88	118·4	10·29	106·0	9·79	96·0	8·12	66·0
9·50	90·3	9·00	81·0	8·57	73·5	7·14	51·0
8·57	73·5	8·12	66·0	7·74	60·0	6·48	42·0
7·89	62·2	7·48	56·0	7·14	51·0	5·95	35·4
7·36	54·2	6·99	48·8	6·67	44·5	5·45	29·7
6·94	48·1	6·59	43·5	6·30	39·7	5·07	25·7
6·59	43·4	6·27	39·3	5·95	35·4	4·78	22·8
6·30	39·7	5·95	35·4	5·60	31·3	4·55	20·7
6·03	36·3	5·63	31·7	5·31	28·2	4·36	19·0
5·73	32·8	5·36	28·7	5·07	25·7	4·20	17·6
5·47	30·0	5·14	26·4	4·87	23·7	4·06	16·5
5·26	27·6	4·95	24·5	4·70	22·0	3·92	15·4
5·07	25·7	4·78	22·8	4·55	20·7	3·79	14·4
4·91	24·1	4·63	21·5	4·41	19·5	3·67	13·5
4·76	22·7	4·50	20·3	4·30	18·5	3·56	12·7
4·63	21·5	4·39	19·3	4·20	17·6	...	...
4·52	20·4	4·29	18·4	4·10	16·8	...	...
4·41	19·5	4·20	17·6	4·02	16·2	...	...
4·32	18·7	4·11	16·9	3·92	15·4	...	...
4·23	17·9	4·04	16·3	3·83	14·7	...	...
4·16	17·3	3·95	15·6	3·75	14·0	...	...
4·09	16·7	3·87	15·0	3·67	13·5	...	...
4·02	16·2	3·79	14·4	3·60	12·9	...	...
3·94	15·5	3·72	13·8	3·53	12·4	...	...
3·87	15·0	3·65	13·3	...	...	...	...
3·80	14·4	3·58	12·8	...	...	...	...
3·73	13·9	3·52	12·4	...	...	...	...
3·67	13·5	...	...	...	...	...	...
3·61	13·0	...	...	...	...	...	...
...	...	...	...	...	...	...	...
F*		G*		H*		I*	

he distinguishing letter in each column refers to the conditions ch the pitches and surfaces are applicable; these conditions, their distinguishing letters, will be found immediately pre- these *Tables.*

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{9}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surfac
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. in
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	17·56	308·5	16·68	278·2	15·74	248·
15	18·13	328·6	17·56	308·5	14·41	207·6	13·69	187·5	12·93	167·
20	15·74	248·0	15·26	232·8	12·54	157·2	11·92	142·1	11·27	127·
25	14·12	199·6	13·69	187·5	11·27	127·0	10·72	114·9	10·14	102·
30	12·93	167·3	12·54	157·2	10·33	106·8	9·83	96·7	9·31	86·
35	12·01	144·2	11·64	135·6	9·61	92·4	9·15	83·7	8·66	75·
40	11·27	127·0	10·92	119·4	9·03	81·6	8·60	74·0	8·15	66·
45	10·65	113·5	10·33	106·8	8·55	73·2	8·15	66·5	7·73	59·
50	10·14	102·8	9·83	96·7	8·15	66·5	7·77	60·4	7·37	54·
55	9·69	94·0	9·40	88·5	7·81	61·0	7·45	55·5	7·07	50·
60	9·31	86·6	9·03	81·6	7·51	56·4	7·16	51·3	6·80	46·
65	...	...	...	...	7·24	52·5	6·92	47·8	6·57	43·
70	...	...	...	...	7·01	49·2	6·70	44·8	6·37	40·
75	...	...	...	...	6·80	46·3	6·50	42·3	6·18	38·
80	...	...	...	...	6·62	43·8	6·32	40·0	5·98	35·
85	...	...	...	...	6·44	41·5	6·16	38·0	5·77	33·
90	...	...	...	...	6·29	39·6	5·98	35·7	5·58	31·
95	...	...	...	...	6·15	37·8	5·79	33·5	5·42	29·
100	...	...	...	...	5·98	35·7	5·62	31·6	5·27	27·
105	...	...	...	...	5·81	33·7	5·47	29·9	5·13	26·
110	...	...	...	...	5·65	32·0	5·33	28·4	5·01	25·
115	...	...	...	...	5·51	30·4	5·21	27·1	4·90	24·
120	...	...	...	...	5·39	29·0	5·09	25·9	4·80	23·
125	...	...	...	...	5·27	27·8	4·99	24·9	4·70	22·
130	...	...	...	...	5·16	26·6	4·89	23·9	4·62	21·
135	...	...	...	...	5·06	25·6	4·80	23·0	4·54	20·
140	...	...	...	...	4·97	24·7	4·71	22·2	4·46	19·
145	...	...	...	...	4·88	23·8	4·64	21·5	4·39	19·
150	...	...	...	...	4·80	23·0	4·56	20·8	4·33	18·
155	...	...	...	...	4·72	22·3	4·50	20·2	4·27	18·
160	...	...	...	...	4·65	21·6	4·43	19·6	4·21	17·
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the condition to which the pitches and surfaces are applicable; these conditions with their distinguishing letters, will be found immediately pre*ceding these Tables.*

The [illegible]
which the [illegible]
their [illegible]
ng these Tables

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{9}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	17·56	308·5	16·68	278·2	15·74	248·0
15	18·13	328·6	17·56	308·5	14·41	207·6	13·69	187·5	12·93	167·3
20	15·74	248·0	15·26	232·8	12·54	157·2	11·92	142·1	11·27	127·0
25	14·12	199·6	13·69	187·5	11·27	127·0	10·72	114·9	10·14	102·8
30	12·93	167·3	12·54	157·2	10·33	106·8	9·83	96·7	9·31	86·6
35	12·01	144·2	11·64	135·6	9·61	92·4	9·15	83·7	8·66	75·1
40	11·27	127·0	10·92	119·4	9·03	81·6	8·60	74·0	8·15	66·5
45	10·65	113·5	10·33	106·8	8·55	73·2	8·15	66·5	7·73	59·7
50	10·14	102·8	9·83	96·7	8·15	66·5	7·77	60·4	7·37	54·4
55	9·69	94·0	9·40	88·5	7·81	61·0	7·45	55·5	7·07	50·0
60	9·31	86·6	9·03	81·6	7·51	56·4	7·16	51·3	6·80	46·3
65	...	...	...	...	7·24	52·5	6·92	47·8	6·57	43·2
70	...	...	...	...	7·01	49·2	6·70	44·8	6·37	40·5
75	...	...	...	...	6·80	46·3	6·50	42·3	6·18	38·2
80	...	...	...	...	6·62	43·8	6·32	40·0	5·98	35·7
85	...	...	...	...	6·44	41·5	6·16	38·0	5·77	33·3
90	...	...	...	...	6·29	39·6	5·98	35·7	5·58	31·2
95	...	...	...	...	6·15	37·8	5·79	33·5	5·42	29·3
100	...	...	...	...	5·98	35·7	5·62	31·6	5·27	27·8
105	...	...	...	...	5·81	33·7	5·47	29·9	5·13	26·4
110	...	...	...	...	5·65	32·0	5·33	28·4	5·01	25·1
115	...	...	...	...	5·51	30·4	5·21	27·1	4·90	24·0
120	...	...	...	...	5·39	29·0	5·09	25·9	4·80	23·0
125	...	...	...	...	5·27	27·8	4·99	24·9	4·70	22·1
130	...	...	...	...	5·16	26·6	4·89	23·9	4·62	21·3
135	...	...	...	...	5·06	25·6	4·80	23·0	4·54	20·6
140	...	...	...	...	4·97	24·7	4·71	22·2	4·46	19·9
145	...	...	...	...	4·88	23·8	4·64	21·5	4·39	19·3
150	...	...	...	...	4·80	23·0	4·56	20·8	4·33	18·7
155	...	...	...	...	4·72	22·3	4·50	20·2	4·27	18·2
160	...	...	...	...	4·65	21·6	4·43	19·6	4·21	17·7
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

TABLE No. 3 *continued.*

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{9}{32}$ inch thick.

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	20·35	414·3	19·21	369·0	18·24	332·7	14·96	223·8
10	14·49	210·1	13·69	187·5	13·01	169·3	10·72	114·9
15	11·92	142·1	11·27	127·0	10·72	114·9	8·86	78·6
20	10·39	108·0	9·83	96·7	9·36	87·6	7·77	60·4
25	9·36	87·6	8·86	78·6	8·44	71·3	7·04	49·5
30	8·60	74·0	8·15	66·5	7·77	60·4	6·50	42·3
35	8·02	64·3	7·60	57·8	7·25	52·6	6·08	36·9
40	7·55	57·0	7·16	51·3	6·84	46·8	5·62	31·6
45	7·16	51·3	6·80	46·3	6·50	42·3	5·27	27·8
50	6·84	46·8	6·50	42·3	6·21	38·6	4·99	24·9
55	6·56	43·1	6·24	39·0	5·91	34·9	4·76	22·6
60	6·32	40·0	5·98	35·7	5·62	31·6	4·56	20·8
65	6·11	37·3	5·70	32·5	5·38	28·9	4·40	19·4
70	5·85	34·2	5·47	29·9	5·17	26·7	4·26	18·1
75	5·62	31·6	5·27	27·8	4·99	24·9	4·14	17·1
80	5·42	29·4	5·09	25·9	4·83	23·3	4·03	16·3
85	5·25	27·5	4·94	24·4	4·69	22·0	3·92	15·3
90	5·09	25·9	4·80	23·0	4·56	20·8	3·81	14·5
95	4·95	24·5	4·67	21·8	4·45	19·8	3·70	13·7
100	4·83	23·3	4·56	20·8	4·35	18·9	3·61	13·0
105	4·71	22·2	4·46	19·9	4·26	18·1	3·52	12·4
110	4·61	21·3	4·37	19·1	4·18	17·4	...	...
115	4·52	20·4	4·29	18·4	4·10	16·8	...	...
120	4·43	19·6	4·21	17·7	4·03	16·3	...	...
125	4·35	18·9	4·14	17·1	3·96	15·6	...	...
130	4·28	18·3	4·07	16·6	3·88	15·0	...	...
135	4·21	17·7	4·01	16·1	3·81	14·5	...	...
140	4·15	17·2	3·94	15·5	3·74	14·0	...	...
145	4·09	16·7	3·87	15·0	3·67	13·5	...	...
150	4·03	16·3	3·81	14·5	3·61	13·0	...	...
155	3·97	15·8	3·74	14·0	3·55	12·6	...	...
160	3·91	15·3	3·69	13·6	3·50	12·2	...	...
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these *Tables.*

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{5}{16}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	19·13	366·0	18·16	330·0	17·14	294·0
15	19·74	390·0	19·13	366·0	15·68	246·0	14·90	222·0	14·07	198·0
20	17·14	294·0	16·61	276·0	13·63	186·0	12·96	168·0	12·24	150·0
25	15·36	236·0	14·90	222·0	12·24	150·0	11·64	135·6	11·01	121·2
30	14·07	198·0	13·63	186·0	11·22	126·0	10·67	114·0	10·10	102·0
35	13·06	170·5	12·66	160·2	10·43	108·8	9·92	98·5	9·39	88·2
40	12·24	150·0	11·87	141·0	9·79	96·0	9·32	87·0	8·83	78·0
45	11·57	134·0	11·22	126·0	9·27	86·0	8·83	78·0	8·36	70·0
50	11·01	121·2	10·67	114·0	8·83	78·0	8·41	70·8	7·97	63·6
55	10·52	110·7	10·20	104·1	8·45	71·4	8·05	64·9	7·64	58·3
60	10·10	102·0	9·79	96·0	8·12	66·0	7·74	60·0	7·34	54·0
65	9·72	94·6	9·43	89·0	7·83	61·3	7·47	55·8	7·09	50·3
70	9·39	88·2	9·11	83·1	7·57	57·4	7·23	52·2	6·86	47·1
75	9·10	82·8	...	...	7·34	54·0	7·01	49·2	6·66	44·4
80	...	...	...	...	7·14	51·0	6·82	46·5	6·48	42·0
85	...	...	...	...	6·95	48·3	6·64	44·1	6·31	39·8
90	...	...	...	...	6·78	46·0	6·48	42·0	6·16	38·0
95	...	...	...	...	6·62	43·8	6·33	40·1	5·98	35·8
100	...	...	...	...	6·48	42·0	6·19	38·4	5·81	33·7
105	...	...	...	...	6·34	40·2	6·05	36·6	5·65	31·9
110	...	...	...	...	6·22	38·7	5·88	34·6	5·50	30·2
115	...	...	...	...	6·10	37·2	5·73	32·9	5·37	28·8
120	...	...	...	...	5·95	35·4	5·60	31·3	5·25	27·5
125	...	...	...	...	5·81	33·7	5·47	29·9	5·13	26·3
130	...	...	...	...	5·68	32·2	5·35	28·7	5·03	25·3
135	...	...	...	...	5·56	30·9	5·25	27·5	4·93	24·3
140	...	...	...	...	5·45	29·7	5·15	26·5	4·85	23·5
145	...	...	...	...	5·34	28·5	5·05	25·5	4·76	22·7
150	...	...	...	...	5·25	27·5	4·97	24·7	4·69	21·9
155	...	...	...	...	5·16	26·6	4·88	23·8	4·61	21·3
160	...	...	...	...	5·07	25·7	4·81	23·1	4·55	20·7
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

TABLE No. 4 *continued.*

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{5}{16}$ inch thick.

F*		G*		H*		I*	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	20·92	438·0	19·87	394·8	16·28	265·2
15·78	249·0	14·90	222·0	14·15	200·4	11·64	135·6
12·96	168·0	12·24	150·0	11·64	135·6	9·61	92·4
11·29	127·5	10·67	114·0	10·15	103·2	8·41	70·8
10·15	103·2	9·61	92·4	9·15	83·7	7·60	57·8
9·32	87·0	8·83	78·0	8·41	70·8	7·01	49·2
8·68	75·4	8·22	67·7	7·84	61·5	6·56	43·4
8·17	66·7	7·74	60·0	7·39	54·6	6·19	38·0
7·74	60·0	7·34	54·0	7·01	49·2	5·81	33·7
7·39	54·6	7·01	49·2	6·70	44·8	5·47	29·9
7·08	50·1	6·72	45·2	6·43	41·3	5·20	27·0
6·82	46·5	6·48	42·0	6·19	38·4	4·97	24·7
6·58	43·3	6·26	39·2	5·94	35·2	4·77	22·8
6·38	40·7	6·05	36·6	5·69	32·3	4·61	21·2
6·19	38·4	5·81	33·7	5·47	29·9	4·46	19·9
5·99	35·9	5·60	31·3	5·28	27·9	4·34	18·8
5·78	33·4	5·41	29·3	5·11	26·1	4·22	17·8
5·60	31·3	5·25	27·5	4·97	24·7	4·13	17·0
5·43	29·5	5·10	26·0	4·83	23·3	4·04	16·3
5·28	27·9	4·97	24·7	4·71	22·2	3·94	15·5
5·15	26·5	4·85	23·5	4·61	21·2	3·84	14·8
5·02	25·2	4·74	22·4	4·51	20·3	3·76	14·1
4·91	24·1	4·64	21·5	4·42	19·5	3·67	13·5
4·81	23·1	4·55	20·7	4·34	18·8	3·60	12·9
4·71	22·2	4·46	19·9	4·26	18·1	3·52	12·4
4·63	21·4	4·38	19·2	4·19	17·5	...	...
4·55	20·7	4·31	18·6	4·13	17·0	...	...
4·47	20·0	4·25	18·0	4·07	16·5	...	...
4·40	19·4	4·18	17·5	4·01	16·1	...	...
4·34	18·8	4·13	17·0	3·94	15·5	...	...
4·28	18·3	4·07	16·6	3·88	15·0	...	...
4·22	17·8	4·02	16·2	3·81	14·5	...	...
F*		G*		H*		I*	

The distinguishing letter in each column refers to the conditions hich the pitches and surfaces are applicable; these conditions, their distinguishing letters, will be found immediately pre-*ng these Tables.*

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{11}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	20·70	428·5	19·65	386·2	18·54	344·0
15	...	...	20·70	428·5	16·96	287·6	16·10	259·8	15·21	231·3
20	18·54	344·0	17·96	322·8	14·74	217·2	14·00	196·0	13·22	175·0
25	16·62	276·4	16·11	259·5	13·22	175·0	12·57	158·1	11·88	141·2
30	15·21	231·3	14·74	217·2	12·11	146·8	11·52	132·7	10·89	118·6
35	14·11	199·1	13·67	187·0	11·25	126·7	10·70	114·6	10·12	102·
40	13·22	175·0	12·82	164·4	10·56	111·6	10·05	101·0	9·51	90
45	12·49	156·2	12·11	146·8	9·99	99·8	9·51	90·5	9·00	81
50	11·88	141·2	11·52	132·7	9·51	90·5	9·05	82·0	8·58	73
55	11·35	128·9	11·01	121·2	9·10	82·8	8·66	75·1	8·21	67
60	10·89	118·6	10·56	111·6	8·74	76·4	8·33	69·3	7·89	62
65	10·48	110·0	10·17	103·5	8·42	71·0	8·03	64·5	7·61	58
70	10·12	102·5	9·82	96·5	8·14	66·3	7·76	60·3	7·36	54
75	9·80	96·1	9·51	90·5	7·89	62·3	7·53	56·7	7·14	51·
80	9·51	90·5	9·23	85·2	7·66	58·8	7·31	53·5	6·94	48·
85	9·24	85·5	...	...	7·46	55·7	7·12	50·7	6·76	45·7
90	9·00	81·0	...	...	7·27	52·9	6·94	48·2	6·60	43·5
95	...	...	...	...	7·10	50·4	6·78	46·0	6·44	41·5
100	...	...	...	...	6·94	48·2	6·63	44·0	6·30	39·8
105	...	...	...	...	6·80	46·2	6·49	42·2	6·18	38·1
110	...	...	...	...	6·66	44·4	6·37	40·5	6·03	36·4
115	...	...	...	...	6·53	42·7	6·25	39·0	5·87	34·5
120	...	...	...	...	6·42	41·2	6·13	37·6	5·73	32·9
125	...	...	...	...	6·30	39·8	6·00	36·0	5·60	31·4
130	...	...	...	...	6·20	38·5	5·86	34·3	5·48	30·0
135	...	...	...	...	6·10	37·2	5·73	32·9	5·37	28·8
140	...	...	...	...	5·97	35·6	5·61	31·5	5·26	27·7
145	...	...	...	...	5·85	34·2	5·51	30·3	5·17	26·7
150	...	...	...	...	5·73	32·9	5·40	29·2	5·07	25·7
155	...	...	...	...	5·63	31·6	5·31	28·2	4·99	24·9
160	...	...	...	...	5·53	30·5	5·22	27·2	4·91	24·1
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately *preceding these Tables.*

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{11}{32}$ inch thick.

TABLE No. 5
continued.

F*		G*		H*		I*	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	17·61	310·2
17·06	291·1	16·11	259·5	15·30	234·1	12·57	158·1
14·00	196·0	13·22	175·0	12·57	158·1	10·36	107·4
12·19	148·5	11·52	132·7	10·95	120·0	9·05	82·0
10·95	120·0	10·36	107·4	9·86	97·2	8·17	66·8
10·05	101·0	9·51	90·5	9·05	82·0	7·53	56·7
9·35	87·4	8·85	78·4	8·43	71·1	7·03	49·4
8·79	77·2	8·33	69·3	7·94	63·0	6·63	44·0
8·33	69·3	7·89	62·3	7·53	56·7	6·30	39·8
7·94	63·0	7·53	56·7	7·18	51·6	6·00	36·0
7·60	57·8	7·21	52·0	6·89	47·4	5·67	32·2
7·31	53·5	6·94	48·2	6·63	44·0	5·40	29·2
7·06	49·8	6·70	45·0	6·41	41·1	5·18	26·8
6·83	46·7	6·49	42·2	6·21	38·5	4·98	24·8
6·63	44·0	6·30	39·8	6·00	36·0	4·81	23·1
6·45	41·6	6·14	37·6	5·77	33·3	4·66	21·7
6·28	39·5	5·92	35·1	5·58	31·1	4·53	20·5
6·13	37·6	5·73	32·9	5·40	29·2	4·42	19·5
5·95	35·4	5·56	30·9	5·25	27·5	4·31	18·6
5·77	33·3	5·40	29·2	5·11	26·1	4·22	17·8
5·61	31·5	5·26	27·7	4·98	24·8	4·14	17·1
5·47	29·9	5·13	26·4	4·87	23·7	4·06	16·5
5·34	28·5	5·02	25·2	4·76	22·7	3·98	15·8
5·22	27·2	4·91	24·1	4·66	21·7	3·90	15·2
5·11	26·1	4·81	23·1	4·58	20·9	3·82	14·6
5·00	25·0	4·72	22·3	4·49	20·2	3·74	14·0
4·91	24·1	4·64	21·5	4·42	19·5	3·67	13·5
4·82	23·2	4·56	20·8	4·35	18·9	3·61	13·0
4·74	22·5	4·49	20·1	4·28	18·3	3·54	12·5
4·66	21·7	4·42	19·5	4·22	17·8	...	...
4·59	21·1	4·35	18·9	4·16	17·3	...	...
4·53	20·5	4·29	18·4	4·11	16·9	...	...
F*		G*		H*		I*	

The distinguishing letter in each column refers to the conditions hich the pitches and surfaces are applicable; these conditions, their distinguishing letters, will be found immediately pre- ng these *Tables.*

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{3}{8}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surfac
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. in
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	19·95	398·
15	...	...	...	...	18·24	332·6	17·32	300·0	16·35	267·
20	19·95	398·0	19·32	373·5	15·84	251·0	15·05	226·5	14·21	202·
25	17·87	319·6	17·32	300·0	14·21	202·0	13·50	182·4	12·76	162·
30	16·35	267·3	15·84	251·0	13·01	169·3	12·37	153·0	11·69	136·
35	15·16	230·0	14·69	216·0	12·08	146·0	11·49	132·0	10·86	118·
40	14·21	202·0	13·77	189·7	11·33	128·5	10·78	116·2	10·19	104·
45	13·42	180·2	13·01	169·3	10·71	114·8	10·19	104·0	9·65	93·1
50	12·76	162·8	12·37	153·0	10·19	104·0	9·70	94·2	9·18	84·
55	12·18	148·5	11·81	139·6	9·75	95·0	9·28	86·1	8·79	77·
60	11·69	136·6	11·33	128·5	9·36	87·6	8·91	79·5	8·44	71·
65	11·25	126·6	10·91	119·0	9·02	81·3	8·59	73·8	8·14	66·
70	10·86	118·0	10·53	111·0	8·71	76·0	8·30	69·0	7·87	62·
75	10·51	110·5	10·19	104·0	8·44	71·3	8·05	64·8	7·63	58·
80	10·19	104·0	9·89	97·8	8·20	67·2	7·81	61·1	7·41	55·
85	9·91	98·2	9·61	92·4	7·97	63·6	7·60	57·8	7·22	52·1
90	9·65	93·1	9·36	87·6	7·77	60·4	7·41	55·0	7·04	49·
95	9·40	88·5	9·13	83·3	7·58	57·5	7·24	52·4	6·87	47·
100	9·18	84·4	...	...	7·41	55·0	7·07	50·1	6·72	45·
105	...	...	...	...	7·25	52·6	6·92	48·0	6·58	43·
110	...	...	...	...	7·11	50·5	6·78	46·0	6·45	41·
115	...	...	...	...	6·97	48·6	6·66	44·3	6·33	40·
120	...	...	...	...	6·84	46·8	6·53	42·7	6·21	38·
125	...	...	...	...	6·72	45·2	6·42	41·2	6·10	37·
130	...	...	...	...	6·61	43·6	6·31	39·9	5·96	35·
135	...	...	...	...	6·50	42·2	6·21	38·6	5·83	34·
140	...	...	...	...	6·40	41.0	6·12	37·5	5·71	32·
145	...	...	...	...	6·30	39·7	5·99	35·9	5·60	31·
150	...	...	...	...	6·21	38·6	5·88	34·5	5·49	30·
155	...	...	...	...	6·13	37·6	5·77	33·2	5·40	29·1
160	...	...	...	...	6·02	36·2	5·66	32·0	5·30	28·1
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{3}{8}$ inch thick.

TABLE NO. 6 *continued.*

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	18·94	358·8
10	18·35	336·7	17·32	300·0	16·45	270·6	13·50	182·4
15	15·05	226·5	14·21	202·0	13·50	182·4	11·11	123·6
20	13·09	171·3	12·37	153·0	11·76	138·3	9·70	94·2
25	11·76	138·3	11·11	123·6	10·57	111·8	8·75	76·5
30	10·78	116·2	10·19	104·0	9·70	94·2	8·05	64·8
35	10·02	100·5	9·48	90·0	9·03	81·6	7·51	56·4
40	9·41	88·6	8·91	79·5	8·49	72·1	7·07	50·1
45	8·91	79·5	8·44	71·3	8·05	64·8	6·72	45·2
50	8·49	72·1	8·05	64·8	7·67	58·9	6·42	41·2
55	8·13	66·1	7·71	59·4	7·35	54·1	6·17	38·0
60	7·81	61·1	7·41	55·0	7·07	50·1	5·88	34·5
65	7·54	56·8	7·15	51·2	6·83	46·7	5·61	31·5
70	7·29	53·2	6·92	48·0	6·61	43·8	5·39	29·0
75	7·07	50·0	6·72	45·2	6·42	41·2	5·19	26·9
80	6·88	47·3	6·53	42·7	6·25	39·0	5·02	25·2
85	6·70	44·9	6·37	40·5	6·08	36·9	4·87	23·7
90	6·53	42·7	6·21	38·6	5·88	34·5	4·73	22·4
95	6·38	40·8	6·06	36·7	5·70	32·4	4·61	21·3
100	6·25	39·0	5·88	34·5	5·53	30·6	4·50	20·3
105	6·12	37·5	5·71	32·6	5·39	29·0	4·41	19·4
110	5·95	35·4	5·56	31·0	5·25	27·6	4·32	18·6
115	5·80	33·7	5·43	29·5	5·13	26·3	4·24	17·9
120	5·66	32·0	5·30	28·1	5·02	25·2	4·16	17·3
125	5·53	30·6	5·19	26·9	4·92	24·2	4·09	16·7
130	5·41	29·3	5·08	25·8	4·82	23·2	4·03	16·2
135	5·30	28·1	4·99	24·9	4·73	22·4	3·96	15·6
140	5·20	27·1	4·90	24·0	4·65	21·6	3·88	15·1
145	5·11	26·1	4·81	23·1	4·57	20·9	3·82	14·5
150	5·02	25·2	4·73	22·4	4·50	20·3	3·75	14·1
155	4·94	24·3	4·66	21·7	4·44	19·7	3·69	13·6
160	4·86	23·6	4·59	21·0	4·38	19·1	3·63	13·2
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{13}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	19·52	381·0	18·53	343·5	17·49	306·0
20	...	...	20·68	427·8	16·94	287·2	16·09	259·1	15·19	231·0
25	19·13	366·0	18·53	343·5	15·19	231·0	14·44	208·5	13·63	186·0
30	17·49	306·0	16·94	287·2	13·91	193·5	13·22	174·7	12·49	156·0
35	16·22	263·1	15·71	247·0	12·91	166·7	12·27	150·6	11·60	134·5
40	15·19	231·0	14·72	216·9	12·10	146·6	11·51	132·5	10·88	118·5
45	14·35	206·0	13·91	193·5	11·44	131·0	10·88	118·5	10·29	106·0
50	13·63	186·0	13·22	174·7	10·88	118·5	10·35	107·2	9·79	96·0
55	13·02	169·6	12·62	159·4	10·40	108·2	9·90	98·0	9·37	87·8
60	12·49	156·0	12·10	146·6	9·98	99·7	9·50	90·3	9·00	81·0
65	12·02	144·4	11·65	135·8	9·62	92·5	9·15	83·8	8·67	75·2
70	11·60	134·5	11·24	126·5	9·29	86·3	8·85	78·3	8·38	70·2
75	11·22	126·0	10·88	118·5	9·00	81·0	8·57	73·5	8·12	66·0
80	10·88	118·5	10·55	111·4	8·73	76·3	8·32	69·2	7·89	62·2
85	10·57	111·8	10·26	105·2	8·49	72·1	8·09	65·5	7·67	58·9
90	10·29	106·0	9·98	99·7	8·27	68·5	7·89	62·2	7·48	56·0
95	10·03	100·7	9·73	94·8	8·07	65·2	7·70	59·2	7·30	53·3
100	9·79	96·0	9·50	90·3	7·89	62·2	7·52	56·6	7·14	51·0
105	9·57	91·7	9·29	86·3	7·71	59·5	7·36	54·2	6·99	48·8
110	9·37	87·8	9·09	82·7	7·55	57·1	7·21	52·0	6·84	46·9
115	9·18	84·2	...	...	7·41	54·9	7·07	50·0	6·71	45·1
120	9·00	81·0	...	...	7·27	52·8	6·94	48·1	6·59	43·5
125	...	...	...	...	7·14	51·0	6·82	46·5	6·48	42·0
130	...	...	...	...	7·02	49·2	6·70	44·9	6·37	40·6
135	...	...	...	...	6·90	47·6	6·59	43·5	6·27	39·3
140	...	...	...	...	6·79	46·1	6·49	42·1	6·17	38·1
145	...	...	...	...	6·69	44·7	6·39	40·9	6·07	36·8
150	...	...	...	...	6·59	43·5	6·30	39·7	5·95	35·4
155	...	...	...	...	6·50	42·2	6·21	38·6	5·83	34·0
160	...	...	...	...	6·41	41·1	6·13	37·6	5·73	32·8
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, *with their distinguishing* letters, will be found immediately *preceding these Tables.*

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{13}{32}$ inch thick.

TABLE No. 7 *continued.*

	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	20·27	411·0
0	19·63	385·6	18·53	343·5	17·60	309·7	14·44	208·5
5	16·09	259·1	15·19	231·0	14·44	208·5	11·87	141·0
0	13·99	195·8	13·22	174·7	12·56	157·8	10·35	107·2
5	12·56	157·8	11·87	141·0	11·29	127·5	9·32	87·0
0	11·51	132·5	10·88	118·5	10·35	107·2	8·57	73·5
5	10·70	114·4	10·12	102·4	9·63	92·7	7·99	63·8
0	10·04	100·9	9·50	90·3	9·05	81·9	7·52	56·6
5	9·50	90·3	9·00	81·0	8·57	73·5	7·14	51·0
0	9·05	81·9	8·57	73·5	8·17	66·7	6·82	46·5
5	8·66	75·0	8·20	67·3	7·82	61·2	6·54	42·8
0	8·32	69·2	7·89	62·2	7·52	56·6	6·30	39·7
5	8·02	64·4	7·61	57·9	7·26	52·7	6·08	37·0
0	7·76	60·2	7·36	54·2	7·02	49·3	5·82	33·9
5	7·52	56·6	7·14	51·0	6·82	46·5	5·60	31·3
0	7·31	53·4	6·94	48·1	6·63	43·9	5·40	29·1
35	7·11	50·6	6·76	45·7	6·46	41·7	5·23	27·3
90	6·94	48·1	6·59	43·5	6·30	39·7	5·07	25·7
95	6·78	45·9	6·44	41·5	6·16	37·9	4·93	24·3
00	6·63	43·9	6·30	39·7	5·99	35·9	4·81	23·1
105	6·49	42·1	6·17	38·1	5·82	33·9	4·70	22·0
110	6·36	40·5	6·03	36·3	5·67	32·1	4·59	21·1
115	6·24	39·0	5·87	34·5	5·53	30·5	4·50	20·2
120	6·13	37·6	5·73	32·8	5·40	29·1	4·41	19·5
125	5·99	35·9	5·60	31·3	5·28	27·9	4·34	18·8
130	5·85	34·3	5·47	30·0	5·17	26·7	4·26	18·2
135	5·73	32·8	5·36	28·8	5·07	25·7	4·20	17·6
140	5·61	31·5	5·26	27·6	4·98	24·8	4·13	17·1
145	5·50	30·3	5·16	26·6	4·89	23·9	4·07	16·6
150	5·40	29·1	5·07	25·7	4·81	23·1	4·02	16·2
155	5·30	28·1	4·99	24·9	4·73	22·4	3·96	15·6
160	5·21	27·2	4·91	24·1	4·66	21·7	3·89	15·1
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding *these Tables.*

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{7}{16}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	20·80	432·6	19·74	390·0	18·63	347·3
20	...	...	...	...	18·05	326·0	17·14	294·0	16·18	262·0
25	20·38	415·6	19·74	390·0	16·18	262·0	15·37	236·4	14·51	210·8
30	18·63	347·3	18·05	326·0	14·81	219·3	14·07	198·0	13·29	176·6
35	17·28	298·5	16·74	280·2	13·74	188·8	13·06	170·5	12·34	152·2
40	16·18	262·0	15·68	246·0	12·88	166·0	12·24	150·0	11·57	134·0
45	15·28	233·5	14·81	219·3	12·17	148·2	11·57	134·0	10·94	119·7
50	14·51	210·8	14·07	198·0	11·57	134·0	11·01	121·2	10·41	108·4
55	13·86	192·1	13·43	180·5	11·06	122·3	10·52	110·7	9·95	99
60	13·29	176·6	12·88	166·0	10·61	112·6	10·10	102·0	9·55	91
65	12·78	163·5	12·39	153·6	10·22	104·4	9·72	94·6	9·20	84
70	12·34	152·2	11·96	143·1	9·87	97·4	9·39	88·2	8·89	79
75	11·93	142·5	11·57	134·0	9·55	91·3	9·10	82·8	8·61	7
80	11·57	134·0	11·22	126·0	9·27	86·0	8·83	78·0	8·36	[illegible]
85	11·24	126·4	10·90	118·9	9·01	81·2	8·58	73·7	8·13	[illegible]
90	10·94	119·7	10·61	112·6	8·78	77·1	8·36	70·0	7·93	[illegible]
95	10·66	113·7	10·34	107·0	8·56	73·3	8·16	66·6	7·74	[illegible]
100	10·41	108·4	10·10	102·0	8·36	70·0	7·97	63·6	7·56	[illegible]
105	10·17	103·5	9·87	97·4	8·18	66·9	7·80	60·8	7·40	[illegible]
110	9·95	99·0	9·65	93·2	8·01	64·1	7·64	58·3	7·24	[illegible]
115	9·75	95·0	9·46	89·4	7·85	61·6	7·49	56·0	7·10	[illegible]
120	9·55	91·3	9·27	86·0	7·70	59·3	7·34	54·0	6·97	[illegible]
125	9·37	87·9	9·10	82·8	7·56	57·2	7·21	52·0	6·85	[illegible]
130	9·20	84·7	...	...	7·43	55·2	7·09	50·3	6·73	[illegible]
135	9·04	81·8	...	...	7·30	53·4	6·97	48·6	6·62	[illegible]
140	...	...	...	...	7·19	51·7	6·86	47·1	6·52	[illegible]
145	...	...	...	...	7·08	50·1	6·76	45·7	6·42	[illegible]
150	...	...	...	...	6·97	48·6	6·66	44·4	6·33	[illegible]
155	...	...	...	...	6·87	47·2	6·57	43·1	6·24	[illegible]
160	...	...	...	...	6·78	46·0	6·48	42·0	6·16	[illegible]
	A*		B*		C*		D*			

* The distinguishing letter in each column refers to the cond[illegible] to which the pitches and surfaces are applicable; these cond[illegible] with their distinguishing letters, will be found immediatel[illegible] *ceding these Tables.*

FLAT SURFACES.

TABLE No. 8. *continued.*

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{7}{16}$ inch thick.

F*		G*		H*		I*	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	...	...
20·92	438·0	19·74	390·0	18·75	351·6	15·37	236·4
17·14	294·0	16·18	262·0	15·37	236·4	12·63	159·6
14·90	222·0	14·07	198·0	13·37	178·8	11·01	121·2
13·37	178·8	12·63	159·6	12·01	144·2	9·90	98·1
12·24	150·0	11·57	134·0	11·01	121·2	9·10	82·8
11·37	129·4	10·75	115·7	10·23	104·7	8·47	71·8
10·67	114·0	10·10	102·0	9·61	92·4	7·97	63·6
10·10	102·0	9·55	91·3	9·10	82·8	7·56	57·2
9·61	92·4	9·10	82·8	8·66	75·1	7·21	52·0
9·19	84·5	8·70	75·8	8·29	68·8	6·92	47·8
8·83	78·0	8·36	70·0	7·97	63·6	6·66	44·4
8·51	72·4	8·06	65·0	7·69	59·1	6·43	41·4
8·22	67·7	7·80	60·8	7·44	55·3	6·23	38·9
7·97	63·6	7·56	57·2	7·21	52·0	6·03	36·4
7·74	60·0	7·34	54·0	7·01	49·2	5·81	33·7
7·53	56·8	7·15	51·1	6·83	46·6	5·61	31·4
7·34	54·0	6·97	48·6	6·66	44·4	5·43	29·5
7·17	51·4	6·81	46·4	6·51	42·3	5·28	27·8
7·01	49·2	6·66	44·4	6·36	40·5	5·13	26·3
6·86	47·1	6·52	42·5	6·23	38·9	5·01	25·1
6·72	45·2	6·39	40·9	6·11	37·3	4·89	23·9
6·60	43·5	6·27	39·3	5·95	35·4	4·78	22·9
6·48	42·0	6·16	38·0	5·81	33·7	4·69	21·9
6·36	40·5	6·03	36·4	5·67	32·2	4·60	21·1
6·26	39·2	5·89	34·7	5·55	30·8	4·51	20·4
6·16	38·0	5·76	33·2	5·43	29·5	4·44	19·7
6·05	36·6	5·65	31·9	5·33	28·4	4·37	19·0
5·92	35·1	5·53	30·6	5·23	27·3	4·30	18·5
5·81	33·7	5·43	29·5	5·13	26·3	4·24	17·9
5·70	32·5	5·34	28·5	5·05	25·5	4·18	17·5
5·60	31·3	5·25	27·5	4·97	24·7	4·13	17·0
F*		G*		H*		I*	

…e distinguishing letter in each column refers to the conditions …h the pitches and surfaces are applicable; these conditions, …heir distinguishing letters, will be found immediately pre- …*these Tables.*

Pressures, Pitches, and Surfaces.
Iron Plate ½ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	20·92	438·0
20	...	...	...	...	20·27	411·0	19·24	370·5	18·16	330·0
25	...	...	...	...	18·16	330·0	17·25	297·6	16·28	265·2
30	20·92	438·0	20·27	411·0	16·61	276·0	15·78	249·0	14·90	222·0
35	19·39	376·2	18·79	353·1	15·40	237·4	14·63	214·2	13·82	191·1
40	18·16	330·0	17·60	309·7	14·44	208·5	13·72	188·2	12·96	168·0
45	17·14	294·0	16·61	276·0	13·63	186·0	12·96	168·0	12·24	150·0
50	16·28	265·2	15·78	249·0	12·96	168·0	12·32	151·8	11·64	135·6
55	15·54	241·6	15·06	226·9	12·38	153·2	11·77	138·5	11·12	123·8
60	14·90	222·0	14·44	208·5	11·87	141·0	11·29	127·5	10·67	114·0
65	14·33	205·3	13·89	192·9	11·42	130·6	10·87	118·1	10·28	105·6
70	13·82	191·1	13·40	179·5	11·03	121·7	10·49	110·1	9·92	98·5
75	13·37	178·8	12·96	168·0	10·67	114·0	10·15	103·2	9·61	92·4
80	12·96	168·0	12·56	157·8	10·35	107·2	9·85	97·1	9·32	87·0
85	12·58	158·4	12·20	148·9	10·06	101·2	9·58	91·7	9·06	82·2
90	12·24	150·0	11·87	141·0	9·79	96·0	9·32	87·0	8·83	78·0
95	11·93	142·4	11·57	133·8	9·55	91·2	9·09	82·7	8·61	74·2
100	11·64	135·6	11·29	127·5	9·32	87·0	8·88	78·9	8·41	70·8
105	11·37	129·4	11·03	121·7	9·11	83·1	8·68	75·4	8·22	67·7
110	11·12	123·8	10·79	116·4	8·92	79·6	8·50	72·2	8·05	64·9
115	10·89	118·6	10·56	111·6	8·74	76·4	8·33	69·3	7·89	62·3
120	10·67	114·0	10·35	107·2	8·57	73·5	8·17	66·7	7·74	60·0
125	10·47	109·6	10·15	103·2	8·41	70·8	8·02	64·3	7·60	57·8
130	10·28	105·6	9·97	99·4	8·26	68·3	7·87	62·0	7·47	55·8
135	10·10	102·0	9·79	96·0	8·12	66·0	7·74	60·0	7·34	54·0
140	9·92	98·5	9·63	92·7	7·99	63·8	7·62	58·0	7·23	52·2
145	9·76	95·3	9·47	89·7	7·86	61·8	7·50	56·2	7·12	50·6
150	9·61	92·4	9·32	87·0	7·74	60·0	7·39	54·6	7·01	49·2
155	9·46	89·6	9·18	84·3	7·63	58·2	7·28	53·0	6·91	47·8
160	9·32	87·0	9·05	81·9	7·52	56·6	7·18	51·5	6·82	46·5
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

TABLE No. 10 *continued.*

Pressures, Pitches, and Surfaces.

Iron Plate ½ inch thick.

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	17·25	297·6
15	19·24	370·5	18·16	330·0	17·25	297·6	14·15	200·4
20	16·71	279·3	15·78	249·0	14·99	224·7	12·32	151·8
25	14·99	224·7	14·15	200·4	13·45	180·9	11·07	122·6
30	13·72	188·2	12·96	168·0	12·32	151·8	10·15	103·2
35	12·73	162·2	12·03	144·8	11·44	130·9	9·45	89·3
40	11·94	142·6	11·29	127·5	10·74	115·3	8·88	78·9
45	11·29	127·5	10·67	114·0	10·15	103·2	8·41	70·8
50	10·74	115·3	10·15	103·2	9·66	93·4	8·02	64·3
55	10·26	105·4	9·71	94·3	9·24	85·5	7·68	59·0
60	9·85	97·1	9·32	87·0	8·88	78·9	7·39	54·6
65	9·49	90·1	8·98	80·7	8·56	73·2	7·13	50·8
70	9·17	84·1	8·68	75·4	8·27	68·4	6·90	47·6
75	8·88	78·9	8·41	70·8	8·02	64·3	6·70	44·8
80	8·62	74·3	8·17	66·7	7·79	60·6	6·51	42·4
85	8·38	70·3	7·94	63·1	7·58	57·4	6·34	40·3
90	8·17	66·7	7·74	60·0	7·39	54·6	6·19	38·4
95	7·97	63·5	7·56	57·1	7·21	52·0	6·03	36·3
100	7·79	60·6	7·39	54·6	7·05	49·7	5·85	34·2
105	7·62	58·0	7·23	52·2	6·90	47·6	5·69	32·3
110	7·46	55·7	7·08	50·1	6·76	45·7	5·54	30·7
115	7·31	53·5	6·94	48·2	6·63	44·0	5·40	29·2
120	7·18	51·5	6·82	46·5	6·51	42·4	5·28	27·9
125	7·05	49·7	6·70	44·8	6·40	40·9	5·17	26·7
130	6·93	48·0	6·58	43·3	6·29	39·6	5·06	25·6
135	6·82	46·5	6·48	42·0	6·19	38·4	4·97	24·7
140	6·71	45·0	6·38	40·7	6·09	37·1	4·88	23·8
145	6·61	43·7	6·28	39·5	5·96	35·6	4·79	23·0
150	6·51	42·4	6·19	38·4	5·85	34·2	4·71	22·2
155	6·42	41·2	6·10	37·3	5·74	32·9	4·64	21·5
160	6·33	40·1	5·99	35·9	5·64	31·7	4·57	20·9
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{17}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	20·30	412·1	19·15	367·0
25	...	...	...	...	19·15	367·0	18·19	330·9	17·17	294·8
30	...	...	...	...	17·51	306·8	16·63	276·7	15·70	246·6
35	20·46	418·5	19·81	392·7	16·24	263·8	15·25	238·0	14·57	212·2
40	19·15	367·0	18·56	344·4	15·22	231·6	14·45	209·0	13·65	186·5
45	18·08	326·8	17·51	306·8	14·37	206·5	13·65	186·5	12·90	166·4
50	17·17	294·8	16·63	276·7	13·65	186·5	12·97	168·4	12·26	150·4
55	16·38	268·5	15·87	252·1	13·04	170·0	12·39	153·6	11·71	137·2
60	15·70	246·6	15·22	231·6	12·50	156·4	11·89	141·3	11·24	126·3
65	15·10	228·1	14·63	214·2	12·03	144·8	11·44	130·9	10·82	117·0
70	14·57	212·2	14·12	199·3	11·61	134·9	11·04	122·0	10·44	109·1
75	14·09	198·5	13·65	186·5	11·24	126·3	10·69	114·3	10·11	102·2
80	13·65	186·5	13·23	175·2	10·90	118·8	10·37	107·5	9·81	96·2
85	13·26	175·8	12·85	165·2	10·59	112·1	10·07	101·5	9·53	90·9
90	12·90	166·4	12·50	156·4	10·31	106·2	9·81	96·2	9·28	86·2
95	12·57	158·0	12·18	148·5	10·05	101·0	9·56	91·5	9·05	82·0
100	12·26	150·4	11·89	141·3	9·81	96·2	9·34	87·2	8·84	78·2
105	11·98	143·5	11·61	134·9	9·59	91·9	9·13	83·3	8·64	74·7
110	11·71	137·2	11·36	129·0	9·38	88·0	8·93	79·8	8·46	71·6
115	11·47	131·5	11·12	123·7	9·19	84·4	8·75	76·6	8·29	68·7
120	11·24	126·3	10·90	118·8	9·01	81·2	8·58	73·6	8·13	66·1
125	11·02	121·5	10·69	114·3	8·84	78·2	8·42	70·9	7·98	63·7
130	10·82	117·0	10·49	110·1	8·68	75·4	8·27	68·4	7·84	61·5
135	10·62	112·9	10·31	106·2	8·53	72·8	8·13	66·1	7·71	59·4
140	10·44	109·1	10·13	102·6	8·39	70·4	8·00	64·0	7·58	57·5
145	10·27	105·5	9·96	99·3	8·26	68·2	7·87	62·0	7·47	55·7
150	10·11	102·2	9·81	96·2	8·13	66·1	7·75	60·1	7·35	54·1
155	9·57	99·1	9·66	93·3	8·01	64·2	7·64	58·4	7·25	52·5
160	9·81	96·2	9·51	90·6	7·90	62·4	7·53	56·7	7·15	51·1
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding *these Tables.*

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{11}{32}$ inch thick.

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch.	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	18·19	330·9
15	20·30	412·1	19·15	367·0	18·19	330·9	14·92	222·6
20	17·62	310·5	16·63	276·7	15·80	249·6	12·97	168·4
25	15·80	249·6	14·92	222·6	14·17	200·9	11·65	135·9
30	14·45	209·0	13·65	186·5	12·97	168·4	10·69	114·3
35	13·41	180·0	12·67	160·7	12·05	145·2	9·94	98·8
40	12·58	158·2	11·89	141·3	11·30	127·8	9·34	87·2
45	11·89	141·3	11·24	126·3	10·69	114·3	8·84	78·2
50	11·30	127·8	10·69	114·3	10·17	103·4	8·42	70·9
55	10·80	116·7	10·22	104·4	9·72	94·6	8·06	65·0
60	10·37	107·5	9·81	96·2	9·34	87·2	7·75	60·1
65	9·98	99·7	9·45	89·3	8·99	80·9	7·48	55·9
70	9·64	93·0	9·13	83·3	8·69	75·6	7·24	52·4
75	9·34	87·2	8·84	78·2	8·42	70·9	7·02	49·3
80	9·06	82·1	8·58	73·6	8·18	66·9	6·82	46·6
85	8·81	77·6	8·34	69·7	7·95	63·3	6·65	44·2
90	8·58	73·6	8·13	66·1	7·75	60·1	6·48	42·1
95	8·37	70·1	7·93	63·0	7·57	57·3	6·34	40·2
100	8·18	66·9	7·75	60·1	7·39	54·7	6·20	38·4
105	8·00	64·0	7·58	57·5	7·24	52·4	6·06	36·7
110	7·83	61·3	7·43	55·2	7·09	50·3	5·89	34·7
115	7·68	58·9	7·28	53·0	6·95	48·3	5·74	33·0
120	7·53	56·7	7·15	51·1	6·82	46·6	5·60	31·4
125	7·39	54·7	7·02	49·3	6·70	44·9	5·48	30·0
130	7·27	52·8	6·90	47·6	6·59	43·4	5·36	28·7
135	7·15	51·1	6·79	46·1	6·48	42·1	5·25	27·6
140	7·03	49·5	6·68	44·6	6·38	40·8	5·15	26·5
145	6·93	48·0	6·58	43·3	6·29	39·6	5·06	25·6
150	6·82	46·6	6·48	42·1	6·20	38·4	4·97	24·7
155	6·73	45·3	6·39	40·9	6·11	37·4	4·89	23·9
160	6·63	44·0	6·31	39·8	6·00	36·9	4·82	23·2
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{9}{16}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	20·15	406·0
25	...	...	...	...	20·15	406·0	19·13	366·0	18·05	326·0
30	...	...	...	...	18·42	339·3	17·49	306·0	16·51	272·6
35	...	...	20·84	434·5	17·08	291·7	16·22	263·1	15·31	234·5
40	20·15	406·0	19·52	381·0	16·00	256·0	15·19	231·0	14·35	206·0
45	19·01	361·5	18·42	339·3	15·10	228·2	14·35	206·0	13·55	183·7
50	18·05	326·0	17·49	306·0	14·35	206·0	13·63	186·0	12·88	166·0
55	17·23	296·9	16·69	278·7	13·70	187·8	13·02	169·6	12·30	151·4
60	16·51	272·6	16·00	256·0	13·14	172·6	12·49	156·0	11·80	139·3
65	15·88	252·1	15·38	236·7	12·64	159·8	12·02	144·4	11·36	129·0
70	15·31	234·5	14·84	220·2	12·20	148·8	11·60	134·5	10·96	120·2
75	14·81	219·3	14·35	206·0	11·80	139·3	11·22	126·0	10·61	112·6
80	14·35	206·0	13·91	193·5	11·44	131·0	10·88	118·5	10·29	106·0
85	13·93	194·2	13·50	182·4	11·12	123·6	10·57	111·8	10·00	100·0
90	13·55	183·7	13·14	172·6	10·82	117·1	10·29	106·0	9·74	94·8
95	13·20	174·4	12·80	163·8	10·54	111·2	10·03	100·7	9·49	90·2
100	12·88	166·0	12·49	156·0	10·29	106·0	9·79	96·0	9·27	86·0
105	12·58	158·3	12·20	148·8	10·06	101·2	9·57	91·7	9·06	82·1
110	12·30	151·4	11·93	142·3	9·84	96·9	9·37	87·8	8·87	78·7
115	12·04	145·1	11·68	136·4	9·64	92·9	9·18	84·2	8·69	75·5
120	11·80	139·3	11·44	131·0	9·45	89·3	9·00	81·0	8·52	72·6
125	11·57	134·0	11·22	126·0	9·27	86·0	8·83	78·0	8·36	70·0
130	11·36	129·0	11·01	121·3	9·10	82·9	8·67	75·2	8·21	67·5
135	11·15	124·5	10·82	117·1	8·94	80·0	8·52	72·6	8·07	65·2
140	10·96	120·2	10·63	113·1	8·80	77·4	8·38	70·2	7·94	63·1
145	10·78	116·3	10·46	109·4	8·65	74·9	8·25	68·0	7·82	61·1
150	10·61	112·6	10·29	106·0	8·52	72·6	8·12	66·0	7·70	59·3
155	10·45	109·2	10·13	102·7	8·39	70·5	8·00	64·0	7·59	57·6
160	10·29	106·0	9·98	99·7	8·27	68·5	7·89	62·2	7·48	56·0
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{9}{16}$ inch thick.

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	19·13	366·0
15	...	...	20·15	406·0	19·13	366·0	15·68	246·0
20	18·53	343·5	17·49	306·0	16·61	276·0	13·63	186·0
25	16·61	276·0	15·68	246·0	14·90	222·0	12·24	150·0
30	15·19	231·0	14·35	206·0	13·63	186·0	11·22	126·0
35	14·10	198·8	13·32	177·4	12·66	160·2	10·43	108·8
40	13·22	174·7	12·49	156·0	11·87	141·0	9·79	96·0
45	12·49	156·0	11·80	139·3	11·22	126·0	9·27	86·0
50	11·87	141·0	11·22	126·0	10·67	114·0	8·83	78·0
55	11·34	128·7	10·72	115·0	10·20	104·1	8·45	71·4
60	10·88	118·5	10·29	106·0	9·79	96·0	8·12	66·0
65	10·48	109·8	9·91	98·3	9·43	89·0	7·83	61·3
70	10·12	102·4	9·57	91·7	9·11	83·1	7·57	57·4
75	9·79	96·0	9·27	86·0	8·83	78·0	7·34	54·0
80	9·50	90·3	9·00	81·0	8·57	73·5	7·14	51·0
85	9·24	85·4	8·75	76·5	8·33	69·5	6·95	48·3
90	9·00	81·0	8·52	72·6	8·12	66·0	6·78	46·0
95	8·77	77·0	8·31	69·1	7·92	62·8	6·62	43·8
100	8·57	73·5	8·12	66·0	7·74	60·0	6·45	42·0
105	8·38	70·2	7·94	63·1	7·57	57·4	6·34	40·2
110	8·20	67·3	7·78	60·5	7·42	55·0	6·22	38·7
115	8·04	64·6	7·62	58·1	7·27	52·9	6·10	37·2
120	7·89	62·2	7·48	56·0	7·14	51·0	5·95	35·4
125	7·74	60·0	7·34	54·0	7·01	49·2	5·81	33·7
130	7·61	57·9	7·22	52·1	6·89	47·5	5·68	32·2
135	7·48	56·0	7·10	50·4	6·78	46·0	5·56	30·9
140	7·36	54·2	6·99	48·8	6·67	44·5	5·45	29·7
145	7·25	52·5	6·88	47·3	6·57	43·2	5·34	28·5
150	7·14	51·0	6·78	46·0	6·48	42·0	5·25	27·5
155	7·04	49·5	6·68	44·7	6·39	40·8	5·16	26·6
160	6·94	48·1	6·59	43·5	6·30	39·7	5·07	25·7
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces

Iron Plate $\frac{5}{8}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surfa
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. in
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	19·83	393·
30	...	...	...	...	20·23	409·3	19·21	369·0	18·13	328·
35	...	...	...	...	18·75	351·7	17·80	317·1	16·81	282·
40	...	...	...	...	17·56	308·5	16·68	278·2	15·74	248·
45	20·88	436·2	20·23	409·3	16·58	274·8	15·74	248·0	14·87	221·1
50	19·83	393·2	19·21	369·0	15·74	248·0	14·96	223·8	14·12	199·
55	18·92	358·0	18·33	336·0	15·03	226·0	14·28	204·0	13·49	182·
60	18·13	328·6	17·56	308·5	14·41	207·6	13·69	187·5	12·93	167·
65	17·43	303·8	16·88	285·2	13·86	192·1	13·17	173·5	12·44	154·
70	16·81	282·5	16·28	265·2	13·37	178·8	12·71	161·5	12·01	144·
75	16·25	264·1	15·74	248·0	12·93	167·3	12·29	151·2	11·62	135·
80	15·74	248·0	15·26	232·8	12·54	157·2	11·92	142·1	11·27	127·
85	15·29	233·7	14·81	219·5	12·18	148·3	11·58	134·1	10·95	119·
90	14·87	221·1	14·41	207·6	11·85	140·4	11·27	127·0	10·65	113·
95	14·48	209·7	14·03	197·0	11·54	133·3	10·98	120·6	10·38	107·
100	14·12	199·6	13·69	187·5	11·27	127·0	10·72	114·9	10·14	102·
105	13·79	190·3	13·37	178·8	11·01	121·2	10·47	109·7	9·91	98·
110	13·49	182·0	13·07	171·0	10·77	116·0	10·24	105·0	9·69	94·
115	13·20	174·3	12·80	163·8	10·54	111·2	10·03	100·6	9·49	90·
120	12·93	167·3	12·54	157·2	10·33	106·8	9·83	96·7	9·31	86·
125	12·68	160·8	12·29	151·2	10·14	102·8	9·65	93·1	9·13	83·
130	12·44	154·9	12·06	145·6	9·95	99·0	9·47	89·7	8·97	80·
135	12·22	149·4	11·85	140·4	9·78	95·6	9·31	86·6	8·81	77·
140	12·01	144·2	11·64	135·6	9·61	92·4	9·15	83·7	8·66	75·
145	11·81	139·5	11·45	131·1	9·45	89·4	9·00	81·0	8·53	72·
150	11·62	135·0	11·27	127·0	9·31	86·6	8·86	78·6	8·39	70·
155	11·44	130·9	11·09	123·0	9·16	84·0	8·73	76·2	8·27	68·
160	11·27	127·0	10·92	119·4	9·03	81·6	8·60	74·0	8·15	66·
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the condition to which the pitches and surfaces are applicable; these conditions with their distinguishing letters, will be found immediately pre*ceding these Tables.*

FLAT SURFACES. Table N[illegible] [illegible]

[illegible]

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{5}{8}$ inch thick.

F*		G*		H*		I*	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	.			
...	...	...	...	...	...		
...	...	...	..			[illegible]	[illegible]
20·35	414·3	19·21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18·24	332·7	17·21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16·68	278·2	15·74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15·47	239·3	14·81	213·4	[illegible]	[illegible]	[illegible]	[illegible]
14·49	210·1	13·69	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13·69	187·5	12·93	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13·01	169·3	12·29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12·43	154·5	11·74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11·92	142·1	11·27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11·47	131·6	10·84	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11·07	122·6	10·47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10·72	114·9	10·13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10·39	108·0	9·83	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10·10	102·0	9·56	91·4	[illegible]	[illegible]	[illegible]	[illegible]
9·83	96·7	9·31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9·59	91·9	9·07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9·36	87·6	8·86	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9·15	83·7	8·66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8·95	80·2	8·48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8·77	77·0	8·31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8·60	74·0	8·15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8·44	71·3	8·00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8·29	68·8	7·86	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8·15	66·5	7·73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8·02	64·3	7·60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7·89	62·3	7·48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7·77	60·4	7·37	54·4	[illegible]	[illegible]	[illegible]	[illegible]
7·66	58·6	7·27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7·55	57·0	7·16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
F*		G*		H*		I*	

he distinguishing letter in each [illegible]
ich the pitches and surfaces are [illegible]
their distinguishing letters, will be found [illegible]
these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{21}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	20·71	429·
30	...	...	...	...	...	...	20·06	402·7	18·93	358·
35	...	...	...	...	19·59	383·8	18·60	346·0	17·55	308·
40	...	...	...	...	18·34	336·6	17·42	303·5	16·44	270·
45	...	...	...	...	17·31	299·8	16·44	270·5	15·52	241·
50	20·71	429·2	20·06	402·7	16·44	270·5	15·62	244·0	14·75	217·
55	19·76	390·7	19·14	366·6	15·69	246·4	14·91	222·4	14·08	198·
60	18·93	358·6	18·34	336·6	15·04	226·4	14·29	204·3	13·50	182·
65	18·20	331·5	17·64	311·1	14·47	209·4	13·75	189·1	12·99	168·
70	17·55	308·2	17·01	289·3	13·96	194·9	13·26	176·0	12·53	157·
75	16·97	288·1	16·44	270·5	13·50	182·3	12·83	164·7	12·12	147·
80	16·44	270·5	15·93	253·9	13·08	171·3	12·44	154·7	11·75	138·
85	15·96	254·9	15·47	239·3	12·71	161·5	12·08	146·0	11·42	130·
90	15·52	241·1	15·04	226·4	12·36	152·9	11·75	138·2	11·11	123·
95	15·12	228·7	14·65	214·8	12·05	145·2	11·45	131·2	10·83	117·
100	14·75	217·6	14·29	204·3	11·75	138·2	11·18	125·0	10·57	111·
105	14·40	207·5	13·96	194·9	11·48	131·9	10·92	119·3	10·33	106·
110	14·08	198·3	13·65	186·3	11·23	126·2	10·68	114·2	10·10	102·
115	13·78	190·0	13·36	178·5	11·00	121·0	10·46	109·5	9·90	98·
120	13·50	182·3	13·08	171·3	10·78	116·2	10·25	105·1	9·70	94·
125	13·24	175·2	12·83	164·7	10·57	111·8	10·06	101·2	9·52	90·
130	12·99	168·7	12·59	158·5	10·38	107·7	9·87	97·5	9·34	87·
135	12·75	162·7	12·36	152·9	10·19	103·9	9·70	94·1	9·18	84·
140	12·53	157·1	12·15	147·6	10·02	100·4	9·54	91·0	9·03	81·
145	12·32	151·9	11·95	142·8	9·86	97·2	9·38	88·0	8·88	78·
150	12·12	147·0	11·75	138·2	9·70	94·1	9·23	85·3	8·74	76·
155	11·93	142·5	11·57	133·9	9·55	91·3	9·09	82·7	8·61	74·
160	11·75	138·2	11·40	129·9	9·41	88·6	8·96	80·3	8·49	72·
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, *with their distinguishing letters, will be found immediately preceding these Tables.*

FLAT SURFACES.

TABLE No. 15 *continued.*

Pressures, Pitches, and Surfaces.
Iron Plate $\frac{21}{32}$ inch thick.

F*		G*		H*		I*	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	17·98	323·4
...	...	20·06	402·7	19·05	363·0	15·62	244·0
19·05	363·0	17·98	323·4	17·07	291·6	14·01	196·4
17·42	303·5	16·44	270·5	15·62	244·0	12·83	164·7
16·15	261·0	15·25	232·7	14·49	210·0	11·91	142·0
15·13	229·1	14·29	204·3	13·58	184·5	11·18	125·0
14·29	204·3	13·50	182·3	12·83	164·7	10·57	111·8
13·58	184·5	12·83	164·7	12·20	148·8	10·06	101·2
12·97	168·3	12·25	150·2	11·65	135·8	9·62	92·5
12·44	154·7	11·75	138·2	11·18	125·0	9·23	85·3
11·97	143·3	11·31	128·0	10·76	115·8	8·90	79·2
11·55	133·5	10·92	119·3	10·39	108·0	8·60	74·0
11·18	125·0	10·57	111·8	10·06	101·2	8·33	69·4
10·84	117·5	10·25	105·1	9·76	95·2	8·09	65·5
10·53	111·0	9·96	99·3	9·48	90·0	7·87	62·0
10·25	105·1	9·70	94·1	9·23	85·3	7·67	58·9
9·99	99·9	9·46	89·5	9·01	81·1	7·49	56·1
9·76	95·2	9·23	85·3	8·79	77·4	7·32	53·6
9·54	91·0	9·03	81·5	8·60	74·0	7·16	51·3
9·33	87·1	8·84	78·1	8·42	70·9	7·02	49·2
9·14	83·6	8·66	75·0	8·25	68·1	6·88	47·4
8·96	80·3	8·49	72·1	8·09	65·5	6·75	45·6
8·79	77·4	8·33	69·4	7·94	63·1	6·64	44·0
8·64	74·6	8·18	67·0	7·80	60·9	6·52	42·6
8·49	72·1	8·04	64·7	7·67	58·9	6·42	41·2
8·35	69·7	7·91	62·6	7·55	57·0	6·32	40·0
8·22	67·5	7·79	60·7	7·43	55·2	6·23	38·8
8·09	65·5	7·67	58·9	7·32	53·6	6·14	37·7
7·97	63·5	7·56	57·1	7·21	52·0	6·03	36·3
7·86	61·7	7·45	55·5	7·11	50·6	5·92	35·0
F*		G*		H*		I*	

The distinguishing letter in each column refers to the conditions
hich the pitches and surfaces are applicable; these conditions,
their distinguishing letters, will be found immediately pre-
ng these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{11}{16}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surfa
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. i
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	20·92	438·0	19·74	390
35	...	...	...	...	20·43	417·4	19·39	376·2	18·30	335
40	...	...	...	...	19·13	366·0	18·16	330·0	17·14	294
45	...	...	...	...	18·05	326·0	17·14	294·0	16·18	262
50	...	...	20·92	438·0	17·14	294·0	16·28	265·2	15·37	236
55	20·61	424·9	19·96	398·7	16·36	267·8	15·54	241·6	14·67	215
60	19·74	390·0	19·13	366·0	15·68	246·0	14·90	222·0	14·07	19
65	18·98	360·4	18·39	338·3	15·08	227·5	14·33	205·3	13·53	18
70	18·30	335·1	17·73	314·5	14·55	211·7	13·82	191·1	13·06	17
75	17·69	313·2	17·14	294·0	14·07	198·0	13·37	178·8	12·63	15
80	17·14	294·0	16·61	276·0	13·63	186·0	12·96	168·0	12·24	15
85	16·64	277·0	16·12	260·1	13·24	175·4	12·58	158·4	11·89	14
90	16·18	262·0	15·68	246·0	12·88	166·0	12·24	150·0	11·57	13
95	15·76	248·5	15·27	233·3	12·55	157·5	11·93	142·4	11·28	12
100	15·37	236·4	14·90	222·0	12·24	150·0	11·64	135·6	11·01	12
105	15·01	225·4	14·55	211·7	11·96	143·1	11·37	129·4	10·75	11
110	14·67	215·4	14·22	202·3	11·70	136·9	11·12	123·8	10·52	11
115	14·36	206·3	13·92	193·8	11·45	131·2	10·89	118·6	10·30	10
120	14·07	198·0	13·63	186·0	11·22	126·0	10·67	114·0	10·10	10
125	13·79	190·3	13·37	178·8	11·01	121·2	10·47	109·6	9·90	9
130	13·53	183·2	13·12	172·1	10·80	116·7	10·28	105·6	9·72	9
135	13·29	176·6	12·88	166·0	10·61	112·6	10·10	102·0	9·55	9
140	13·06	170·5	12·66	160·2	10·43	108·8	9·92	98·5	9·39	8
145	12·84	164·8	12·44	154·9	10·26	105·3	9·76	95·3	9·24	8
150	12·63	159·6	12·24	150·0	10·10	102·0	9·61	92·4	9·10	8
155	12·43	154·6	12·05	145·3	9·94	98·9	9·46	89·6	8·96	8
160	12·24	150·0	11·87	141·0	9·79	96·0	9·32	87·0	8·83	7
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditi to which the pitches and surfaces are applicable ; these conditio with their distinguishing letters, will be found immediately p ceding these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{11}{16}$ inch thick.

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surf
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq.
5	...	...	...	...	...	...	...	.
10	...	...	...	...	...	...	...	.
15	...	...	...	...	...	...	18·75	35
20	...	...	20·92	438·0	19·87	394·8	16·28	26
25	19·87	394·8	18·75	351·6	17·80	317·0	14·60	21
30	18·16	330·0	17·14	294·0	16·28	265·2	13·37	17
35	16·84	283·7	15·90	252·8	15·10	228·1	12·41	15
40	15·78	249·0	14·90	222·0	14·15	200·4	11·64	13
45	14·90	222·0	14·07	198·0	13·37	178·8	11·01	12
50	14·15	200·4	13·37	178·8	12·71	161·5	10·47	10
55	13·51	182·7	12·77	163·0	12·14	147·3	10·01	10
60	12·96	168·0	12·24	150·0	11·64	135·6	9·61	9
65	12·47	155·5	11·78	138·9	11·20	125·6	9·26	8
70	12·03	144·8	11·37	129·4	10·82	117·0	8·94	8
75	11·64	135·6	11·01	121·2	10·47	109·6	8·66	7
80	11·29	127·5	10·67	114·0	10·15	103·2	8·41	7
85	10·97	120·3	10·37	107·6	9·87	97·4	8·18	6
90	10·67	114·0	10·10	102·0	9·61	92·4	7·97	6
95	10·40	108·3	9·84	96·9	9·37	87·8	7·78	6
100	10·15	103·2	9·61	92·4	9·15	83·7	7·60	5
105	9·92	98·5	9·39	88·2	8·94	80·0	7·44	5
110	9·71	94·3	9·19	84·5	8·75	76·6	7·28	5
115	9·51	90·5	9·00	81·0	8·58	73·6	7·14	5
120	9·32	87·0	8·83	78·0	8·41	70·8	7·01	4
125	9·15	83·7	8·66	75·1	8·25	68·2	6·89	4
130	8·98	80·7	8·51	72·4	8·11	65·8	6·77	4
135	8·83	78·0	8·36	70·0	7·97	63·6	6·66	4
140	8·68	75·4	8·22	67·7	7·84	61·5	6·56	4
145	8·54	73·0	8·09	65·5	7·72	59·6	6·46	4
150	8·41	70·8	7·97	63·6	7·60	57·8	6·36	4
155	8·29	68·7	7·85	61·7	7·49	56·1	6·28	3
160	8·17	66·7	7·74	60·0	7·39	54·6	6·19	3
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditi[illegible] to which the pitches and surfaces are applicable; these conditio[illegible] with their distinguishing letters, will be found immediately [illegible] ceding these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{23}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	20·55	422·6
35	...	...	...	...	...	...	20·19	407·7	19·05	363·1
40	...	...	...	...	19·91	396·6	18·91	357·5	17·84	318·5
45	...	...	...	...	18·79	353·2	17·84	318·5	16·84	283·7
50	...	...	...	...	17·84	318·5	16·94	287·2	16·00	256·0
55	...	...	20·78	432·1	17·03	290·0	16·17	261·6	15·27	233·2
60	20·55	422·6	19·91	396·6	16·32	266·4	15·50	240·3	14·64	214·3
65	19·76	390·6	19·14	366·5	15·69	246·3	14·91	222·3	14·08	198·3
70	19·05	363·1	18·46	340·8	15·14	229·2	14·38	206·8	13·58	184·5
75	18·42	339·3	17·84	318·5	14·64	214·3	13·91	193·5	13·14	172·6
80	17·84	318·5	17·29	298·9	14·18	201·3	13·48	181·7	12·73	162·2
85	17·32	300·1	16·78	281·7	13·77	189·8	13·09	171·4	12·37	153·0
90	16·84	283·7	16·32	266·4	13·40	179·6	12·73	162·2	12·03	144·8
95	16·40	269·1	15·89	252·7	13·05	170·4	12·41	154·0	11·73	137·5
100	16·00	256·0	15·50	240·3	12·73	162·2	12·10	146·6	11·44	131·0
105	15·62	244·0	15·14	229·2	12·44	154·8	11·83	139·9	11·18	125·0
110	15·27	233·2	14·80	219·0	12·16	148·0	11·56	133·8	10·93	119·6
115	14·94	223·3	14·48	209·8	11·91	141·8	11·32	128·2	10·71	114·6
120	14·64	214·3	14·18	201·3	11·67	136·2	11·09	123·1	10·49	110·1
125	14·35	206·0	13·91	193·5	11·44	131·0	10·88	118·5	10·29	106·0
130	14·08	198·3	13·64	186·2	11·23	126·1	10·68	114·1	10·10	102·1
135	13·82	191·1	13·40	179·6	11·03	121·7	10·49	110·1	9·93	98·5
140	13·58	184·5	13·16	173·4	10·84	117·6	10·31	106·4	9·76	95·2
145	13·35	178·4	12·94	167·6	10·66	113·7	10·14	102·9	9·60	92·2
150	13·14	172·6	12·73	162·2	10·49	110·1	9·98	99·7	9·45	89·3
155	12·93	167·2	12·53	157·2	10·33	106·8	9·83	96·7	9·30	86·6
160	12·73	162·2	12·34	152·4	10·18	103·6	9·69	93·8	9·17	84·1
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{23}{32}$ inch thick.

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	19·52	381·0
20	...	...	...	...	20·68	427·8	16·94	287·2
25	20·68	427·8	19·52	381·0	18·53	343·5	15·19	231·0
30	18·91	357·5	17·84	318·5	16·94	287·2	13·91	193·5
35	17·53	307·3	16·54	273·8	15·71	247·0	12·91	166·7
40	16·42	269·6	15·50	240·3	14·72	216·9	12·10	146·6
45	15·50	240·3	14·64	214·3	13·91	193·5	11·44	131·0
50	14·72	216·9	13·91	193·5	13·22	174·7	10·88	118·5
55	14·06	197·7	13·28	176·4	12·62	159·4	10·40	108·2
60	13·48	181·7	12·73	162·2	12·10	146·6	9·98	99·7
65	12·97	168·2	12·25	150·2	11·65	135·8	9·62	92·5
70	12·51	156·6	11·83	139 9	11·24	126·5	9·29	86·3
75	12·10	146·6	11·44	131·0	10·88	118·5	9·00	81·0
80	11·74	137·8	11·09	123·1	10·55	111·4	8·73	76·3
85	11·40	130·0	10·78	116·2	10·26	105·2	8·49	72·1
90	11·09	123·1	10·49	110·1	9·98	99·7	8·27	68·5
95	10·81	117·0	10·23	104·6	9·73	94·8	8·07	65·2
100	10·55	111·4	9·98	99·7	9·50	90·3	7·89	62·2
105	10·31	106·4	9·76	95·2	9·29	86·3	7·71	59·5
110	10·09	101·8	9·55	91·2	9·09	82·7	7·55	57·1
115	9·88	97·7	9·35	87·5	8·90	79·3	7·41	54·9
120	9·69	93·8	9·17	84·1	8·73	76·3	7·27	52·8
125	9·50	90·3	9·00	81·0	8·57	73·5	7·14	51·0
130	9·33	87·1	8·83	78·1	8·42	70·9	7·02	49·2
135	9·17	84·1	8·68	75·4	8·27	68·5	6·90	47·6
140	9·01	81·3	8·54	72·9	8·14	66·2	6·79	46·1
145	8·87	78·7	8·40	70·6	8·01	64·1	6·69	44·7
150	8·73	76·3	8·27	68·5	7·89	62·2	6·59	43·5
155	8·60	74·0	8·15	66·4	7·77	60·4	6·50	42·2
160	8·48	71·9	8·03	64·5	7·66	58·7	6·41	41·1
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{25}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	20·55	422·5
40	...	...	...	...	...	...	20·39	416·0	19·24	370·5
45	...	...	...	...	20·27	411·0	19·24	370·5	18·16	330·0
50	...	...	...	...	19·24	370·5	18·27	334·0	17·25	297·6
55	...	...	...	...	18·36	337·3	17·44	304·2	16·46	271·0
60	...	...	...	...	17·60	309·7	16·71	279·3	15·78	249·0
65	...	...	20·65	426·5	16·92	286·3	16·07	258·3	15·17	230·3
70	20·55	422·5	19·91	396·5	16·32	266·3	15·50	240·3	14·63	214·2
75	19·87	394·8	19·24	370·5	15·78	249·0	14·99	224·7	14·15	200·4
80	19·24	370·5	18·64	347·7	15·29	233·8	14·52	211·0	13·72	188·2
85	18·68	349·0	18·10	327·6	14·84	220·4	14·10	198·9	13·32	177·5
90	18·16	330·0	17·60	309·7	14·44	208·5	13·72	188·2	12·96	168·0
95	17·69	312·9	17·14	293·7	14·06	197·8	13·30	178·6	12·62	159·4
100	17·25	297·6	16·71	279·3	13·72	188·2	13·04	170·0	12·32	151·8
105	16·84	283·7	16·32	266·3	13·40	179·5	12·73	162·2	12·03	144·8
110	16·46	271·0	15·95	254·5	13·10	171·6	12·45	155·1	11·77	138·5
115	16·11	259·5	15·61	243·7	12·82	164·4	12·19	148·6	11·52	132·7
120	15·78	249·0	15·29	233·8	12·56	157·8	11·94	142·6	11·29	127·5
125	15·46	239·2	14·99	224·7	12·32	151·8	11·71	137·2	11·07	122·6
130	15·17	230·3	14·70	216·2	12·09	146·1	11·49	132·1	10·87	118·1
135	14·90	222·0	14·44	208·5	11·87	141·0	11·29	127·5	10·67	114·0
140	14·63	214·2	14·18	201·2	11·67	136·1	11·09	123·1	10·49	110·1
145	14·39	207·1	13·94	194·5	11·47	131·6	10·91	119·1	10·32	106·5
150	14·15	200·4	13·72	188·2	11·29	127·5	10·74	115·3	10·15	103·2
155	13·93	194·1	13·50	182·3	11·11	123·5	10·57	111·3	10·00	100·0
160	13·72	188·2	13·29	176·8	10·95	119·9	10·41	108·5	9·85	97·1
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

TABLE N[o.]
continu[ed]

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{11}{16}$ inch thick.

F*		G*		E*		I*
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.
...	...	...	..	..	..	...
...	...	...	..	..	...	..
...	...	...	..	..	...	16·27
...	...	...	..	19·94	397·6	16·85
20·89	436·0	19·24	370·1	18·27	334·0	14·99
18·90	357·4	17·84	318·3	16·94	287·2	13·90
17·76	315·5	16·71	279·1	15·97	255·0	12·96
16·71	279·3	15·75	248·0	14·99	224·7	12·22
15·87	252·0	14·99	224·7	14·24	202·8	11·71
15·15	229·6	14·31	204·8	13·60	184·9	11·29
14·52	211·0	13·72	188·2	13·04	170·0	10·74
13·97	195·2	13·20	174·2	12·54	157·4	10·34
13·46	181·7	12·73	162·2	12·10	146·3	9·95
13·04	170·0	12·32	151·8	11·71	137·2	9·66
12·64	159·7	11·94	142·6	11·35	129·0	9·38
12·27	150·7	11·60	134·6	11·05	122·7	9·12
11·94	142·6	11·29	127·5	10·74	115·3	8·85
11·64	135·4	11·00	121·1	10·46	109·5	8·66
11·35	129·0	10·74	115·3	10·22	104·4	8·46
11·09	123·1	10·49	110·1	9·98	99·7	8·27
10·85	117·8	10·26	105·4	9·77	95·4	8·10
10·62	112·9	10·05	101·0	9·57	91·5	7·94
10·41	108·5	9·85	97·1	9·38	88·0	7·79
10·21	104·4	9·66	93·4	9·20	84·7	7·64
10·03	100·6	9·49	90·1	9·04	81·7	7·51
9·85	97·1	9·32	87·0	8·88	78·9	7·39
9·68	93·8	9·17	84·1	8·73	76·2	7·27
9·53	90·8	9·02	81·4	8·59	73·8	7·15
9·38	88·0	8·88	78·9	8·46	71·6	7·05
9·24	85·8	8·75	76·5	8·34	69·4	6·95
9·10	82·8	8·62	74·3	8·21	67·4	6·85
F*		G*		E*		I*

The distinguishing letter in each column refers to the condi[tions]
[un]der which the pitches and surfaces are applicable; these condi[tions,]
[with] their distinguishing letters, will be found immediately
[precedi]ng these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{27}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	20·65	426·5
45	...	...	...	...	...	...	20·65	426·5	19·48	379·7
50	...	...	...	...	20·65	426·5	19·60	384·4	18·50	342·4
55	...	...	...	...	19·70	388·2	18·71	350·0	17·65	311·8
60	...	...	...	...	18·87	356·4	17·92	321·3	16·92	286·3
65	...	...	...	...	18·15	329·4	17·23	297·1	16·27	264·7
70	...	...	...	...	17·50	306·3	16·62	276·3	15·69	246·2
75	...	...	20·65	426·5	16·92	286·3	16·07	258·3	15·17	230·2
80	20·65	426·5	17·32	300·2	16·39	268·8	15·57	242·5	14·70	216·2
85	20·04	401·7	19·41	377·0	15·91	253·3	15·12	228·6	14·27	203·8
90	19·48	379·7	18·87	356·4	15·48	239·6	14·70	216·2	13·88	192·
95	18·97	360·1	18·38	337·9	15·07	227·3	14·32	205·1	13·53	183·
100	18·50	342·4	17·92	321·3	14·70	216·2	13·97	195·2	13·19	174·
105	18·06	326·3	17·50	306·3	14·36	206·2	13·64	186·2	12·89	166·
110	17·65	311·8	17·10	292·7	14·04	197·1	13·34	178·0	12·60	158·
115	17·27	298·5	16·74	280·2	13·74	188·8	13·06	170·5	12·34	152·
120	16·92	286·3	16·39	268·8	13·46	181·2	12·79	163·6	12·09	146·
125	16·58	275·1	16·07	258·3	13·19	174·2	12·54	157·3	11·85	140·
130	16·27	264·7	15·76	248·5	12·95	167·7	12·31	151·5	11·63	135·
135	15·97	255·1	15·48	239·6	12·71	161·7	12·09	146·1	11·42	130·
140	15·69	246·2	15·20	231·2	12·49	156·1	11·88	141·1	11·23	126·
145	15·42	238·0	14·95	223·5	12·28	151·0	11·68	136·5	11·04	122·
150	15·17	230·2	14·70	216·2	12·09	146·1	11·49	132·1	10·86	118·
155	14·93	223·0	14·47	209·4	11·90	141·6	11·31	128·0	10·70	114·
160	14·70	216·2	14·25	203·1	11·72	137·4	11·14	124·2	10·54	111·
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{27}{32}$ inch thick.

TABLE NO. 21 *continued.*

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	19·60	384·4
25	...	...	...	...	...	...	17·57	308·7
30	...	...	20·65	426·5	19·60	384·4	16·07	258·3
35	20·28	411·4	19·14	366·4	18·17	330·3	14·90	222·2
40	18·99	360·7	17·92	321·3	17·02	289·8	13·97	195·2
45	17·92	321·3	16·92	286·3	16·07	258·3	13·19	174·2
50	17·02	289·8	16·07	258·3	15·26	233·0	12·54	157·3
55	16·25	264·0	15·34	235·3	14·57	212·4	11·98	143·6
60	15·57	242·5	14·70	216·2	13·97	195·2	11·49	132·1
65	14·97	224·3	14·14	200·0	13·44	180·6	11·06	122·4
70	14·44	208·7	13·64	186·2	12·96	168·1	10·68	114·1
75	13·97	195·2	13·19	174·2	12·54	157·3	10·34	106·9
80	13·54	183·3	12·79	163·6	12·16	147·9	10·03	100·6
85	13·15	172·9	12·42	154·4	11·81	139·5	9·75	95·0
90	12·79	163·6	12·09	146·1	11·49	132·1	9·49	90·1
95	12·46	155·3	11·78	138·7	11·20	125·5	9·25	85·6
100	12·16	147·9	11·49	132·1	10·93	119·5	9·03	81·6
105	11·88	141·1	11·23	126·1	10·68	114·1	8·83	78·0
110	11·62	135·0	10·98	120·6	10·45	109·2	8·65	74·8
115	11·37	129·4	10·75	115·6	10·23	104·7	8·47	71·8
120	11·14	124·2	10·54	111·1	10·03	100·6	8·31	69·0
125	10·93	119·5	10·34	106·9	9·84	96·8	8·15	66·5
130	10·73	115·1	10·15	103·0	9·66	93·3	8·01	64·2
135	10·54	111·1	9·97	99·4	9·49	90·1	7·87	62·0
140	10·36	107·3	9·80	96·1	9·33	87·0	7·75	60·0
145	10·19	103·8	9·64	93·0	9·18	84·3	7·62	58·2
150	10·03	100·6	9·49	90·1	9·03	81·6	7·51	56·4
155	9·87	97·5	9·34	87·3	8·90	79·2	7·40	54·8
160	9·73	94·7	9·21	84·8	8·77	76·9	7·30	53·3
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{29}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	20·81	433·1
50	...	...	...	...	...	...	20·94	438·4	19·75	390·4
55	...	...	...	...	...	...	19·97	399·1	18·85	355·4
60	...	...	...	...	20·16	406·4	19·14	366·3	18·06	326·3
65	...	...	...	...	19·38	375·6	18·40	338·6	17·37	301·6
70	...	...	...	...	18·68	349·2	17·74	314·8	16·75	280·5
75	...	...	...	...	18·06	326·3	17·15	294·3	16·19	262·2
80	...	...	...	...	17·50	306·3	16·62	276·2	15·69	246·2
85	...	...	20·73	429·9	16·99	288·6	16·13	260·3	15·23	232·1
90	20·81	433·1	20·16	406·4	16·52	272·9	15·69	246·2	14·81	219·5
95	20·26	410·6	19·63	385·3	16·09	258·8	15·28	233·6	14·43	208·3
100	19·75	390·4	19·14	366·3	15·69	246·2	14·90	222·2	14·07	198·2
105	19·29	372·0	18·68	349·2	15·32	234·8	14·55	211·9	13·75	189·0
110	18·85	355·4	18·26	333·6	14·98	224·4	14·23	202·5	13·44	180·7
115	18·44	340·2	17·87	319·3	14·66	214·9	13·93	194·0	13·15	173·1
120	18·06	326·3	17·50	306·3	14·36	206·2	13·64	186·1	12·89	166·1
125	17·70	313·5	17·15	294·3	14·07	198·2	13·37	178·9	12·64	159·7
130	17·37	301·6	16·82	283·2	13·81	190·8	13·12	172·3	12·40	153·8
135	17·05	290·7	16·52	272·9	13·56	183·9	12·89	166·1	12·18	148·3
140	16·75	280·5	16·23	263·4	13·26	177·6	12·66	160·4	11·97	143·2
145	16·46	271·1	15·95	254·5	13·10	171·6	12·45	155·1	11·77	138·5
150	16·19	262·2	15·69	246·2	12·89	166·1	12·25	150·1	11·58	134·1
155	15·93	254·0	15·44	238·5	12·68	161·0	12·06	145·5	11·40	130·0
160	15·69	246·2	15·20	231·2	12·49	156·1	11·88	141·1	11·23	126·1
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{29}{32}$ inch thick.

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Su
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq.
5	...	...	...	...	...	...	...	
10	...	...	...	...	...	...	...	
15	...	...	...	...	...	...	...	
20	...	...	...	...	...	...	20·94	43
25	...	...	...	...	...	...	18·76	35
30	...	...	...	...	20·94	438·4	17·15	29
35	...	...	20·44	417·8	19·40	376·6	15·91	25
40	20·28	411·4	19·14	366·3	18·17	330·3	14·90	22
45	19·14	366·3	18·06	326·3	17·15	294·3	14·07	19
50	18·17	330·3	17·15	294·3	16·29	265·4	13·37	17
55	17·34	300·8	16·37	268·0	15·55	241·8	12·77	16
60	16·62	276·2	15·69	246·2	14·90	222·2	12·25	15
65	15·98	255·4	15·09	227·7	14·33	205·5	11·79	13
70	15·41	237·6	14·55	211·9	13·83	191·3	11·38	12
75	14·90	222·2	14·07	198·2	13·37	178·9	11·01	12
80	14·44	208·7	13·64	186·1	12·96	168·1	10·68	11
85	14·02	196·7	13·25	175·5	12·59	158·6	10·38	10
90	13·64	186·1	12·89	166·1	12·25	150·1	10·10	10
95	13·29	176·7	12·56	157·7	11·94	142·5	9·85	9
100	12·96	168·1	12·25	150·1	11·65	135·7	9·61	9
105	12·66	160·4	11·97	143·2	11·38	129·5	9·40	8
110	12·38	153·4	11·70	137·0	11·13	123·9	9·20	8
115	12·12	147·0	11·46	131·3	10·90	118·8	9·01	8
120	11·88	141·1	11·23	126·1	10·68	114·1	8·83	7
25	11·65	135·7	11·01	121·3	10·47	109·7	8·67	7
30	11·43	130·7	10·81	116·8	10·28	105·7	8·51	7
35	11·23	126·1	10·62	112·7	10·10	102·1	8·37	7
40	11·03	121·8	10·43	108·9	9·93	98·6	8·23	6
45	10·85	117·8	10·26	105·4	9·77	95·4	8·10	6
50	10·68	114·1	10·10	102·1	9·61	92·4	7·97	6
55	10·51	110·6	9·95	99·0	9·47	89·7	7·86	6
60	10·36	107·3	9·80	96·0	9·33	87·0	7·75	6
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the condit which the pitches and surfaces are applicable; these conditi ith their distinguishing letters, will be found immediately ding these *Tables.*

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{15}{16}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	20·38	415·6
55	...	...	...	...	...	...	20·61	424·9	19·45	378·3
60	...	...	...	...	20·80	432·6	19·74	390·0	18·63	347·3
65	...	...	...	...	19·99	399·8	18·98	360·4	17·91	321·0
70	...	...	...	...	19·28	371·7	18·30	335·1	17·28	298·5
75	...	...	...	...	18·63	347·3	17·69	313·2	16·70	279·0
80	...	...	...	...	18·05	326·0	17·14	294·0	16·18	262·0
85	...	...	...	...	17·52	307·1	16·64	277·0	15·71	246·9
90	...	...	20·80	432·6	17·04	290·4	16·18	262·0	15·28	233·5
95	20·90	437·1	20·25	410·2	16·59	275·4	15·76	248·5	14·88	221·5
100	20·38	415·6	19·74	390·0	16·18	262·0	15·37	236·4	14·51	210·8
105	19·90	396·0	19·28	371·7	15·80	249·8	15·01	225·4	14·18	201·0
110	19·45	378·3	18·84	355·0	15·45	238·7	14·67	215·4	13·86	192·1
115	19·03	362·1	18·43	339·9	15·12	228·6	14·36	206·3	13·56	184·0
120	18·63	347·3	18·05	326·0	14·81	219·3	14·07	198·0	13·29	176·6
125	18·26	333·6	17·69	313·2	14·51	210·8	13·79	190·3	13·03	169·8
130	17·91	321·0	17·36	301·3	14·24	202·9	13·53	183·2	12·78	163·5
135	17·59	309·4	17·04	290·4	13·98	195·6	13·29	176·6	12·55	157·7
140	17·28	298·5	16·74	280·2	13·74	188·8	13·06	170·5	12·34	152·2
145	16·98	288·4	16·45	270·8	13·51	182·5	12·84	164·8	12·13	147·2
150	16·70	279·0	16·18	262·0	13·29	176·6	12·63	159·6	11·93	142·5
155	16·44	270·2	15·93	253·7	13·08	171·1	12·43	154·6	11·75	138·1
160	16·18	262·0	15·68	246·0	12·88	166·0	12·24	150·0	11·57	134·0
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate $\frac{15}{16}$ inch thick.

TABLE No. 24 *continued.*

F*		G*		H*		I*	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	19·35	374·6
...	...	...	...	...	...	17·69	313·2
...	...	...	...	20·02	400·9	16·41	269·3
20·92	438·0	19·74	390·0	18·75	351·6	15·37	236·4
19·74	390·0	18·63	347·3	17·69	313·2	14·51	210·8
18·75	351·6	17·69	313·2	16·80	282·4	13·79	190·3
17·89	320·1	16·89	285·2	16·04	257·3	13·17	173·5
17·14	294·0	16·18	262·0	15·37	236·4	12·63	159·6
16·48	271·8	15·56	242·3	14·78	218·6	12·15	147·7
15·90	252·8	15·01	225·4	14·26	203·4	11·73	137·6
15·37	236·4	14·51	210·8	13·79	190·3	11·35	128·8
14·90	222·0	14·07	198·0	13·37	178·8	11·01	121·2
14·46	209·2	13·66	186·7	12·98	168·6	10·69	114·4
14·07	198·0	13·29	176·6	12·63	159·6	10·41	108·4
13·70	187·8	12·95	167·6	12·31	151·5	10·15	103·0
13·37	178·8	12·63	159·6	12·01	144·2	9·90	98·1
13·06	170·5	12·34	152·2	11·73	137·6	9·68	93·7
12·77	163·0	12·06	145·6	11·47	131·6	9·47	89·7
12·50	156·2	11·81	139·5	11·23	126·2	9·28	86·1
12·24	150·0	11·57	134·0	11·01	121·2	9·10	82·8
12·01	144·2	11·35	128·8	10·79	116·5	8·93	79·7
11·78	138·9	11·14	124·1	10·59	112·3	8·76	76·8
11·57	134·0	10·94	119·7	10·41	108·4	8·61	74·2
11·37	129·4	10·75	115·7	10·23	104·7	8·47	71·8
11·18	125·1	10·58	111·9	10·06	101·3	8·34	69·5
11·01	121·2	10·41	108·4	9·90	98·1	8·21	67·4
10·83	117·4	10·25	105·0	9·75	95·1	8·09	65·4
10·67	114·0	10·10	102·0	9·61	92·4	7·97	63·6
F*		G*		H*		I*	

The distinguishing letter in each column refers to the conditions ich the pitches and surfaces are applicable; these conditions, their distinguishing letters, will be found immediately pre- *these Tables.*

Pressures, Pitches, and Surfaces.

Iron Plate 1 inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	20·64	426·3
60	...	...	...	...	...	...	20·96	439·5	19·78	391·3
65	...	...	...	...	...	...	20·15	406·1	19·01	361·6
70	...	...	...	...	20·46	418·8	19·43	377·5	18·33	336·2
75	...	...	...	...	19·78	391·3	18·78	352·8	17·72	314·2
80	...	...	...	...	19·16	367·2	18·19	331·1	17·17	295·0
85	...	...	...	...	18·60	346·0	17·66	312·0	16·67	278·0
90	...	...	...	...	18·08	327·1	17·17	295·0	16·21	262·8
95	...	...	...	...	17·61	310·2	16·72	279·7	15·79	249·3
100	...	...	...	...	17·17	295·0	16·31	266·1	15·40	237·2
105	...	...	20·46	418·8	16·77	281·2	15·92	253·7	15·04	226·1
110	20·64	426·3	20·00	400·0	16·39	268·7	15·57	242·4	14·70	216·1
115	20·20	408·0	19·57	382·9	16·04	257·3	15·23	232·1	14·39	207·0
120	19·78	391·3	19·16	367·2	15·71	246·8	14·92	222·7	14·09	198·6
125	19·38	375·9	18·78	352·8	15·40	237·2	14·63	214·0	13·81	190·9
130	19·01	361·6	18·42	339·4	15·11	228·3	14·35	206·0	13·55	183·8
135	18·66	348·5	18·08	327·1	14·83	220·0	14·09	198·6	13·31	177·2
140	18·33	336·2	17·76	315·6	14·57	212·4	13·84	191·7	13·08	171·1
145	18·02	324·8	17·46	304·9	14·32	205·3	13·61	185·3	12·86	165·4
150	17·72	314·2	17·17	295·0	14·09	198·6	13·39	179·4	12·65	160·1
155	17·44	304·3	16·90	285·6	13·87	192·4	13·18	173·8	12·45	155·1
160	17·17	295·0	16·64	276·9	13·66	186·6	12·98	168·5	12·26	150·5
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Table No. 26 *continued.*

Pressures, Pitches, and Surfaces.

Iron Plate 1 inch thick.

F*		G*		H*		I*	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	20·54	422·1
...	...	...	...	...	...	18·78	352·8
...	...	...	...	...	...	17·41	303·2
...	...	20·96	439·5	19·90	396·1	16·31	266·1
20·96	439·5	19·78	391·3	18·78	352·8	15·40	237·2
19·90	396·1	18·78	352·8	17·83	318·1	14·63	214·0
18·99	360·6	17·92	321·2	17·02	289·7	13·97	195·1
18·19	331·1	17·17	295·0	16·31	266·1	13·39	179·4
17·49	306·1	16·51	272·7	15·68	246·0	12·88	166·0
16·87	284·6	15·92	253·7	15·13	228·9	12·43	154·6
16·31	266·1	15·40	237·2	14·63	214·0	12·03	144·2
15·80	249·8	14·92	222·7	14·18	201·0	11·66	136·0
15·34	235·5	14·49	210·0	13·77	189·6	11·33	128·4
14·92	222·7	14·09	198·6	13·39	179·4	11·02	121·6
14·53	211·3	13·73	188·5	13·04	170·2	10·74	115·5
14·18	201·0	13·39	179·4	12·73	162·0	10·49	110·0
13·84	191·7	13·08	171·1	12·43	154·6	10·25	105·0
13·54	183·3	12·79	163·6	12·16	147·8	10·03	100·5
13·25	175·6	12·52	156·7	11·90	141·7	9·82	96·4
12·98	168·5	12·26	150·5	11·66	136·0	9·62	92·7
12·73	162·0	12·03	144·7	11·43	130·8	9·44	89·2
12·49	156·0	11·80	139·3	11·22	126·0	9·27	86·0
12·26	150·5	11·59	134·4	11·02	121·6	9·11	83·0
12·05	145·3	11·39	129·8	10·83	117·4	8·96	80·3
11·85	140·5	11·20	125·5	10·66	113·6	8·81	77·5
11·66	136·0	11·02	121·6	10·49	110·0	8·68	75·3
11·48	131·8	10·85	117·8	10·32	106·6	8·55	73·1
11·31	127·9	10·69	114·3	10·17	103·5	8·42	71·0
F*		G*		H*		I*	

'he distinguishing letter in each column refers to the conditions ich the pitches and surfaces are applicable; these conditions, their distinguishing letters, will be found immediately pre- g *these Tables.*

Pressures, Pitches, and Surfaces.

Iron Plate $1\frac{1}{16}$ inch thick.

Pressure per sq.in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	20·92	438·0
65	...	...	...	...	...	...	...	...	20·11	404·7
70	...	...	...	...	...	...	20·55	422·5	19·39	376·2
75	...	...	...	...	20·92	438·0	19·87	394·8	18·75	351·6
80	...	...	...	...	20·27	411·0	19·24	370·5	18·16	330·0
85	...	...	...	...	19·67	387·1	18·68	349·0	17·63	310·9
90	...	...	...	...	19·13	366·0	18·16	330·0	17·14	294·0
95	...	...	...	...	18·63	347·0	17·69	312·9	16·69	278·8
100	...	...	...	...	18·16	330·0	17·25	297·6	16·28	265·2
105	...	...	...	...	17·73	314·5	16·84	283·7	15·90	252·8
110	...	...	...	...	17·33	300·5	16·46	271·0	15·54	241·6
115	...	...	20·70	428·6	16·96	287·7	16·11	259·5	15·21	231·3
120	20·92	438·0	20·27	411·0	16·61	276·0	15·78	249·0	14·90	222·0
125	20·51	420·7	19·87	394·8	16·28	265·2	15·46	239·2	14·60	213·3
130	20·11	404·7	19·49	379·8	15·97	255·2	15·17	230·3	14·33	205·3
135	19·74	390·0	19·13	366·0	15·68	246·0	14·90	222·0	14·07	198·0
140	19·39	376·2	18·79	353·1	15·40	237·4	14·63	214·2	13·82	191·1
145	19·06	363·5	18·47	341·1	15·14	229·4	14·39	207·1	13·59	184·7
150	18·75	351·6	18·16	330·0	14·90	222·0	14·15	200·4	13·37	178·8
155	18·45	340·4	17·87	319·5	14·66	215·0	13·93	194·1	13·16	173·2
160	18·16	330·0	17·60	309·7	14·44	208·5	13·72	188·2	12·96	168·0
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Iron Plate 1$\frac{1}{16}$ inch thick.

TABLE No. 28 continued.

F*		G*		H*		I*	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	—	—	—	—	—	—
...	...	—	—	—	—	—	—
...	...	—	—	—	—	—	—
...	...	—	—	—	—	—	—
...	...	—	—	—	—	—	—
...	...	—	—	—	—	19·87	394·8
...	...	—	—	—	—	18·41	339·2
...	...	—	—	—	—	17·25	297·6
...	...	20·92	438·0	19·87	394·8	16·28	265·2
...	...	19·87	394·8	18·86	355·9	15·46	239·2
20·09	403·6	18·96	359·4	18·00	324·1	14·76	218·0
19·24	370·5	18·16	330·0	17·25	297·6	14·15	200·4
18·50	342·4	17·46	305·0	16·58	275·1	13·61	185·4
17·84	318·4	16·84	283·7	15·99	255·9	13·13	172·6
17·25	297·6	16·28	265·2	15·46	239·2	12·71	161·5
16·68	278·2	15·78	249·0	14·99	224·7	12·32	151·8
16·22	263·2	15·32	234·7	14·55	211·8	11·96	143·2
15·78	249·0	14·90	222·0	14·15	200·4	11·64	135·6
15·37	236·2	14·51	210·6	13·79	190·1	11·34	128·7
14·99	224·7	14·15	200·4	13·42	180·9	11·07	122·6
14·63	214·2	13·82	191·1	13·13	172·6	10·82	117·0
14·31	204·8	13·51	182·7	12·84	165·0	10·58	112·0
14·00	196·1	13·23	175·0	12·57	158·1	10·36	107·4
13·72	188·2	12·96	168·0	12·32	151·8	10·15	103·2
13·42	180·9	12·71	161·5	12·08	145·9	9·96	99·3
13·20	174·2	12·47	155·5	11·85	140·5	9·78	95·7
12·96	168·0	12·24	150·0	11·64	135·6	9·61	92·4
12·73	162·2	12·03	144·8	11·44	130·9	9·45	89·3
12·52	156·8	11·83	140·0	11·25	126·6	9·29	86·4
12·32	151·8	11·64	135·6	11·07	122·6	9·15	83·7
12·12	147·0	11·46	131·4	10·90	118·8	9·01	81·2
11·94	142·6	11·29	127·5	10·74	115·3	8·88	78·9
F*		G*		H*		I*	

The distinguishing letter in each column refers to the conditions [w]hich the pitches and surfaces are applicable ; these conditions, [wit]h their distinguishing letters, will be found immediately pre[ced]ing *these Tables*.

Pressures, Pitches, and Surfaces
Iron Plate $1\frac{3}{32}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitc
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	...
65	...	...	...	...	...	...	...	...	20·[illegible]
70	...	...	...	...	...	...	...	...	19·[illegible]
75	...	...	...	...	...	...	20·41	416·7	19·[illegible]
80	...	...	...	...	20·82	433·8	19·77	391·0	18·[illegible]
85	...	...	...	...	20·21	408·6	19·19	368·3	18·[illegible]
90	...	...	...	...	19·65	386·2	18·66	348·2	17·[illegible]
95	...	...	...	...	19·13	366·2	18·17	330·2	17·[illegible]
100	...	...	...	...	18·66	348·2	17·72	314·0	16·[illegible]
105	...	...	...	...	18·22	331·9	17·30	299·3	16·[illegible]
110	...	...	...	...	17·80	317·1	16·91	286·0	15·[illegible]
115	...	...	...	...	17·42	303·6	16·54	273·8	15·[illegible]
120	...	...	20·82	433·8	17·06	291·2	16·20	262·6	15·[illegible]
125	...	...	20·41	416·7	16·72	279·8	15·88	252·4	15·[illegible]
130	20·67	427·2	20·02	400·9	16·41	269·2	15·58	242·9	14·[illegible]
135	20·28	411·6	19·65	386·2	16·11	259·5	15·30	234·1	14·[illegible]
140	19·92	397·1	19·30	372·6	15·82	250·4	15·03	226·0	14·[illegible]
145	19·58	383·6	18·97	360·0	15·55	242·0	14·78	218·4	13·[illegible]
150	19·26	371·0	18·66	348·2	15·30	234·1	14·53	211·3	13·[illegible]
155	18·95	359·2	18·36	337·2	15·06	226·8	14·30	204·7	13·[illegible]
160	18·66	348·2	18·08	326·8	14·83	219·9	14·09	198·5	13·[illegible]
	A*		B*		C*		D*		

* The distinguishing letter in each column refers to the co[illegible] to which the pitches and surfaces are applicable; these co[illegible] with their distinguishing letters, will be found immediat[illegible] *ceding these Tables.*

FLAT SURFACES.

TABLE No. 29 *continued.*

Pressures, Pitches, and Surfaces.

Iron Plate $1\frac{3}{32}$ inch thick

Pressure per sq. in.	F*		G*		H*		I*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	20·41	416·7
35	...	...	...	...	...	...	18·92	358·0
40	...	...	...	...	...	...	17·72	314·0
45	...	...	...	...	20·41	416·7	16·72	279·8
50	...	...	20·41	416·7	19·38	375·6	15·88	252·4
55	20·64	426·0	19·47	379·3	18·49	342·0	15·16	230·0
60	19·77	391·0	18·66	348·2	17·72	314·0	14·53	211·3
65	19·01	361·4	17·94	321·9	17·04	290·3	13·98	195·5
70	18·33	336·0	17·30	299·3	16·43	270·0	13·49	182·0
75	17·72	314·0	16·72	279·8	15·88	252·4	13·05	170·2
80	17·16	294·7	16·20	262·6	15·39	237·0	12·65	160·0
85	16·66	277·7	15·73	247·5	14·94	223·4	12·28	150·9
90	16·20	262·6	15·30	234·1	14·53	211·3	11·95	142·9
95	15·78	249·1	14·90	222·1	14·16	200·5	11·64	135·6
00	15·39	237·0	14·53	211·3	13·81	190·8	11·36	129·2
05	15·03	226·0	14·19	201·5	13·49	182·0	11·10	123·3
0	14·69	216·0	13·88	192·6	13·19	174·0	10·86	118·0
5	14·38	206·8	13·58	184·5	12·91	166·7	10·63	113·1
0	14·09	198·5	13·30	177·1	12·65	160·0	10·42	108·6
5	13·81	190·8	13·05	170·2	12·40	153·8	10·22	104·5
0	13·55	183·7	12·80	163·9	12·17	148·1	10·03	100·7
5	13·30	177·1	12·57	158·1	11·95	142·9	9·86	97·2
0	13·07	171·0	12·35	152·6	11·74	138·0	9·69	94·0
15	12·85	165·3	12·15	147·6	11·55	133·4	9·53	90·9
50	12·65	160·0	11·95	142·9	11·36	129·2	9·38	88·1
55	12·45	155·0	11·76	138·4	11·19	125·2	9·24	85·4
60	12·26	150·3	11·59	134·3	11·02	121·5	9·11	83·0
	F*		G*		H*		I*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable ; these conditions, with their distinguishing letters, will be found immediately pre- *ceding these Tables.*

Pressures, Pitches, and Surfaces.

Iron Plate $1\frac{1}{8}$ inch thick.

Pressure per sq. in.	A*		B*		C*		D*		E*	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	...	...
65	...	...	...	...	...	...	...	...	..	...
70	...	...	...	...	...	...	...	...	20·46	418·5
75	...	...	...	...	...	...	20·95	439·2	19·77	391·0
80	...	...	...	...	...	...	20·30	412·1	19·15	367·0
85	...	...	...	...	20·75	430·7	19·70	388·2	18·59	345·7
90	...	...	...	...	20·17	407·1	19·15	367·0	18·08	326·0
95	...	...	...	...	19·64	386·0	18·65	340·0	17·60	310·0
100	...	...	...	...	19·15	367·0	18·19	330·9	17·17	294·8
105	...	...	...	...	18·70	349·8	17·76	315·4	16·76	281·0
110	...	...	...	...	18·28	334·1	17·36	301·3	16·38	268·5
115	...	...	...	...	17·88	319·9	16·98	288·5	16·03	257·1
120	...	...	...	...	17·51	306·8	16·63	276·7	15·70	246·6
125	...	...	20·95	439·2	17·17	294·8	16·30	265·9	15·39	237·0
130	...	...	20·55	422·5	16·84	283·6	15·99	255·9	15·10	228·1
135	20·83	433·8	20·17	407·1	16·53	273·4	15·70	246·6	14·83	219·9
140	20·46	418·5	19·81	392·7	16·24	263·8	15·43	238·0	14·57	212·2
145	20·10	404·3	19·48	379·4	15·96	254·9	15·16	230·0	14·32	205·1
150	19·77	391·0	19·15	367·0	15·70	246·6	14·92	222·6	14·09	198·5
155	19·45	378·6	18·85	355·3	15·45	238·9	14·68	215·6	13·86	192·3
160	19·15	367·0	18·56	344·4	15·22	231·6	14·45	209·0	13·65	186·5
	A*		B*		C*		D*		E*	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Table No. 30 *continued.*

Pressures, Pitches, and Surfaces.

Iron Plate $1\frac{1}{8}$ inch thick.

F*		G*		H*		I*	
Pitch.	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	20·95	439·2
...	...	...	...	...	...	19·42	377·3
...	...	...	...	...	...	18·19	330·9
...	...	...	...	20·95	439·2	17·17	294·8
...	...	20·95	439·2	19·89	395·8	16·30	265·9
...	...	19·99	399·8	18·98	360·4	15·56	242·2
20·30	412·1	19·15	367·0	18·19	330·9	14·92	222·6
19·51	380·8	18·41	339·2	17·49	305·9	14·35	205·9
18·81	354·1	17·76	315·4	16·86	284·4	13·84	191·6
18·19	330·9	17·17	294·8	16·30	265·9	13·39	179·2
17·62	310·5	16·63	276·7	15·80	249·6	12·97	168·4
17·10	292·6	16·15	260·8	15·34	235·3	12·60	158·8
16·63	276·7	15·70	246·6	14·92	222·6	12·26	150·4
16·20	262·5	15·29	234·0	14·53	211·2	11·95	142·8
15·80	249·6	14·92	222·6	14·17	200·9	11·66	135·9
15·43	238·0	14·57	212·2	13·84	191·6	11·39	129·7
15·08	227·5	14·24	202·9	13·53	183·2	11·14	124·1
14·76	217·8	13·94	194·3	13·24	175·5	10·91	119·0
14·45	209·0	13·65	186·5	12·97	168·4	10·69	114·3
14·17	200·9	13·39	179·2	12·72	161·9	10·48	109·9
13·90	193·4	13·13	172·6	12·48	155·9	10·29	105·9
13·65	186·5	12·90	166·4	12·26	150·4	10·11	102·2
13·42	180·0	12·67	160·7	12·05	145·2	9·94	98·8
13·19	174·0	12·46	155·3	11·85	140·4	9·77	95·6
12·97	168·4	12·26	150·4	11·66	135·9	9·62	92·6
12·77	163·2	12·07	145·7	11·48	131·7	9·47	89·8
12·58	158·2	11·89	141·3	11·30	127·8	9·34	87·2
F*		G*		H*		I*	

The distinguishing letter in each column refers to the conditions ich the pitches and surfaces are applicable ; these conditions, their distinguishing letters, will be found immediately pre- g these *Tables.*

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

Stress on Iron Stays, 5000 lbs. per square inch of net section.

The following notes will facilitate the use of the Tables which immediately follow, numbered 31 to 35 :—

(1) If the working pressure be 120 lbs., the surface to be supported by one stay 175 square inches, and the size of the stay be required :—

Then, opposite 120 lbs. in Table No. 34, the surface, 175 square inches, is found under the diameter 2 $^{5}/_{16}$ inches, and area 4·2 square inches, which is the size of stay required.

(2) If the surface be 120 square inches, the stay 1⅞ inch diameter, area 2·7612 square inches, and working pressure be required :—

Then, in Table No. 33, 1⅞ inch diameter stay is found; and in the column under the area 2·7612 square inches, and 1⅞ inch diameter, the surface is 120 square inches, and opposite it the pressure is 115 lbs.; this is the working pressure suitable.

(3) If the stay be 1 inch diameter, the area ·7854 square inch, the working pressure 80 lbs., and the greatest surface for such size of stay and working pressure be required :—

Then, in Table No. 31, 1 inch stay is found, and opposite 80 lbs. in the column for 1 inch diameter, area ·7854 inch, the surface is 49 square inches; this is the surface suitable for such stay and pressure.

When the surface is not found opposite the pressure, it will be on the side of safety to adopt the larger size of stay over the next greater surface on the right.

The diameter is always the net effective diameter, or diameter at the bottom of the thread, if screwed; and the area, the net sectional area at the smallest part of the stay.

When the stays are not screwed, but have eyes or palms on the ends, the net sectional area of the Iron in the eyes or palms should be in excess of that in the body of the stay. The eyes should have a sectional area of metal of about 50 per cent. greater than that in the body of the stay, and the palm ends should also have a net section of at least 50 per cent. above that in the body of the stay. The distance from the centre of the holes, for the bolts or rivets, to the outer end of palms should be about twice the diameter of the bolts or rivets.

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

TABLE No. 31.

Stress on Iron Stay, 5000 lbs. per square inch of net section.*

Pressure per square inch.	Area 0·1963 sq. inch.	Area 0·2485 sq. inch.	Area 0·3068 sq. inch.	Area 0·3712 sq. inch	Area 0·4417 sq. inch.	Area 0·5184 sq. inch.	Area 0·6013 sq. inch.	Area 0·6902 sq. inch.	Area 0·7854 sq. inch.
	Diam. ½ inch.	Diam. 9/16 inch.	Diam. ⅝ inch.	Diam. 11/16 inch.	Diam. ¾ inch.	Diam. 13/16 inch.	Diam. ⅞ inch.	Diam. 15/16 inch.	Diam. 1 inch.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	196·3	248·5	306·8	371·2	441·7	518·4	601·3	690·2	785·4
10	98·1	124·2	153·3	185·6	220·8	259·2	300·6	345·1	392·7
15	65·4	82·8	102·2	123·7	147·2	172·8	200·4	230·0	261·8
20	49·0	62·1	76·7	92·8	110·4	129·6	150·3	172·5	196·3
25	39·2	49·7	61·3	74·2	88·3	103·6	120·2	138·0	157·0
30	32·7	41·4	51·1	61·8	73·6	86·4	100·2	115·0	130·9
35	28·0	35·5	43·8	53·0	63·1	74·0	85·9	98·6	112·2
40	24·5	31·0	38·3	46·4	55·2	64·8	75·1	86·2	98·1
45	21·8	27·6	34·0	41·2	49·0	57·6	66·8	76·7	87·2
50	19·6	24·8	30·6	37·1	44·1	51·8	60·1	69·0	78·5
55	17·8	22·5	27·8	33·7	40·1	47·1	54·6	62·7	71·4
60	16·3	20·7	25·5	30·9	36·8	43·2	50·1	57·5	65·4
65	15·1	19·1	23·6	28·5	33·9	39·8	46·2	53·1	60·4
70	14·0	17·7	21·9	26·5	31·5	37·0	42·9	49·3	56·1
75	13·0	16·5	20·4	24·7	29·4	34·5	40·0	46·0	52·3
80	12·2	15·5	19·1	23·2	27·6	32·4	37·5	43·1	49·0
85	...	14·7	18·0	21·8	25·9	30·5	35·3	40·6	46·2
90	...	13·8	17·0	20·6	24·5	28·8	33·4	38·3	43·6
95	...	13·0	16·1	19·5	23·2	27·2	31·6	36·3	41·3
00	...	12·4	15·3	18·5	22·0	25·9	30·0	34·5	39·2
05	...	...	14·6	17·6	21·0	24·6	28·6	32·8	37·4
10	...	...	13·9	16·8	20·0	23·5	27·3	31·3	35·7
15	...	...	13·3	16·1	19·2	22·5	26·1	30·0	34·1
20	...	...	12·7	15·4	18·4	21·6	25·0	28·7	32·7
25	...	...	12·2	14·8	17·6	20·7	24·0	27·6	31·4
30	...	...	...	14·2	16·9	19·9	23·1	26·5	30·2
35	...	...	...	13·7	16·3	19·2	22·2	25·5	29·0
40	...	...	...	13·2	15·7	18·5	21·4	24·6	28·0
45	...	...	...	12·8	15·2	17·8	20·7	23·8	27·0
50	...	...	...	12·3	14·7	17·2	20·0	23·0	26·1
55	...	...	...	...	14·2	16·7	19·3	22·2	25·3
60	...	...	...	...	13·8	16·2	18·7	21·5	24·5

* 5000 lbs. per square inch of net section is the greatest working tress to which iron stays, which have been welded or worked in the re, should *be subjected.*

Stress on Iron Stay, 5000 lbs. per square inch of net section.*

Pressure per square inch.	Area 0·8866 sq. inch.	Area 0·9940 sq. inch.	Area 1·1075 sq. inch.	Area 1·2272 sq. inch.	Area 1·3530 sq. inch.	Area 1·4849 sq. inch.	Area 1·6230 sq. inch.	Area 1·7671 sq. inch.	Area 1·917 sq. inch.
	Diam. $1\frac{1}{16}$ inch.	Diam. $1\frac{1}{8}$ inch.	Diam. $1\frac{3}{16}$ inch	Diam. $1\frac{1}{4}$ inch.	Diam. $1\frac{5}{16}$ inch.	Diam. $1\frac{3}{8}$ inch.	Diam. $1\frac{7}{16}$ inch.	Diam. $1\frac{1}{2}$ inch.	Diam. $1\frac{9}{16}$ inch.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	886·6	994·0	...	...	...	...	...	...	...
10	443·3	497·0	553·7	613·6	676·5	742·4	811·5	883·5	958·7
15	295·5	331·3	369·1	409·0	451·0	494·9	541·0	589·0	639·1
20	221·6	248·5	276·8	306·8	338·2	371·2	405·7	441·7	479·3
25	177·3	198·8	221·5	245·4	270·6	296·9	324·6	353·4	383·5
30	147·7	165·6	184·5	204·5	225·5	247·4	270·5	294·5	319·5
35	126·6	142·0	158·2	175·3	193·2	212·1	231·8	252·4	273·9
40	110·8	124·2	138·4	153·4	169·1	185·6	202·8	220·8	239·6
45	98·5	110·4	123·0	136·3	150·3	164·9	180·3	196·3	213·0
50	88·6	99·4	110·7	122·7	135·3	148·4	162·3	176·7	191·7
55	80·6	90·3	100·6	111·5	123·0	134·9	147·5	160·6	174·
60	73·8	82·8	92·2	102·2	112·7	123·7	135·2	147·2	159
65	68·2	76·4	85·1	94·3	104·0	114·2	124·8	135·9	147
70	63·3	71·0	79·1	87·6	96·6	106·0	115·9	126·2	13
75	59·1	66·2	73·8	81·8	90·2	98·9	108·2	117·8	12
80	55·4	62·1	69·2	76·6	84·5	92·8	101·4	110·4	1
85	52·1	58·4	65·1	72·1	79·5	87·3	95·4	103·9	1
90	49·2	55·2	61·5	68·1	75·1	82·4	90·1	98·1	
95	46·6	52·3	58·2	64·5	71·2	78·1	85·4	93·0	
100	44·3	49·7	55·3	61·3	67·6	74·2	81·1	88·3	
105	42·2	47·3	52·7	58·4	64·4	70·7	77·2	84·1	
110	40·3	45·1	50·3	55·7	61·5	67·4	73·7	80·3	
115	38·5	43·2	48·1	53·3	58·8	64·5	70·5	76·8	
120	36·9	41·4	46·1	51·1	56·3	61·8	67·6	73·6	
125	35·4	39·7	44·3	49·0	54·1	59·3	64·9	70·6	
130	34·1	38·2	42·5	47·1	52·0	57·1	62·4	67·9	
135	32·0	36·8	41·0	45·4	50·1	54·9	60·1	65·4	
140	31·6	35·5	39·5	43·8	48·3	53·0	57·9	63·1	
145	30·5	34·2	38·1	42·3	46·6	51·2	55·9	60·9	
150	29·5	33·1	36·9	40·9	45·1	49·4	54·1	58·9	
155	28·6	32·0	35·7	39·5	43·6	47·8	52·3	57·0	
160	27·7	31·0	34·6	38·3	42·2	46·4	50·7	55·2	

* 5000 lbs. per square inch of net section is the greatest w stress to which iron stays, which have been welded or worked i *fire, should be subjected.*

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

TABLE No. 33.

on Iron Stay, 5000 lbs. per square inch of net section.*

9 s.	Area 2·2365 sq. ins.	Area 2·4053 sq. ins.	Area 2·5802 sq. ins.	Area 2·7612 sq. ins.	Area 2·9483 sq. ins.	Area 3·1416 sq. ins.	Area 3·3410 sq. ins.	Area 3·5466 sq. ins.
., .	Diam. $1\frac{11}{16}$ inch.	Diam. $1\frac{3}{4}$ inch.	Diam. $1\frac{13}{16}$ inch.	Diam. $1\frac{7}{8}$ inch.	Diam. $1\frac{15}{16}$ inch.	Diam. 2 inches.	Diam. $2\frac{1}{16}$ inches.	Diam. $2\frac{1}{8}$ inches.
ce s.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...
3	745·5	801·7	860·0	920·4	982·7	...	...	...
4	559·1	601·3	645·0	690·3	737·0	785·4	835·2	886·6
7	447·3	481·0	516·0	552·2	589·6	628·3	668·2	709·3
6	372·7	400·8	430·0	460·2	491·3	523·6	556·8	591·1
2	319·5	343·6	368·6	394·4	421·1	448·8	477·3	506·6
2	279·5	300·6	322·5	345·1	368·5	392·7	417·6	443·3
4	248·5	267·2	286·6	306·8	327·5	349·0	371·2	394·0
3	223·6	240·5	258·0	276·1	294·8	314·1	334·1	354·6
5	203·3	218·6	234·5	251·0	268·0	285·6	303·7	322·4
8	186·3	200·4	215·0	230·1	245·6	261·8	278·4	295·5
5	172·0	185·0	198·4	212·4	226·7	241·6	257·0	272·8
1	159·7	171·8	184·3	197·2	210·5	224·4	238·6	253·3
2	149·1	160·3	172·0	184·0	196·5	209·4	222·7	236·4
6	139·7	150·3	161·2	172·5	184·2	196·3	208·8	221·6
9	131·5	141·4	151·7	162·4	173·4	184·8	196·5	208·6
2	124·2	133·6	143·3	153·4	163·7	174·5	185·6	197·0
1	117·7	126·5	135·8	145·3	155·1	165·3	175·8	186·6
6	111·8	120·2	129·0	138·0	147·4	157·0	167·0	177·3
7	106·5	114·5	122·8	131·4	140·3	149·6	159·1	168·8
2	101·6	109·3	117·2	125·5	134·0	142·8	151·8	161·2
1	97·2	104·5	112·1	120·0	128·1	136·5	145·2	154·2
4	93·1	100·2	107·5	115·0	122·8	130·9	139·2	147·7
9	89·4	96·2	103·2	110·4	117·9	125·6	133·6	141·8
7	86·0	92·5	99·2	106·2	113·3	120·8	128·5	136·4
8	82·8	89·0	95·5	102·2	109·1	116·3	123·7	131·3
0	79·8	85·9	92·1	98·6	105·2	112·2	119·3	126·6
5	77·1	82·9	88·9	95·2	101·6	108·3	115·2	122·2
1	74·5	80·1	86·0	92·0	98·2	104·7	111·3	118·2
9	72·1	77·5	83·2	89·0	95·1	101·3	107·7	114·4
8	69·8	75·1	80·6	86·2	92·1	98·1	104·4	110·8

lbs. per square inch of net section is the greatest working
vhich iron stays, which have been welded or worked in the
d be subjected.

Stress on Iron Stay, 5000 lbs. per square inch of net section.*

Pressure per square inch.	Area 3·7583 sq. ins.	Area 3·9761 sq. ins.	Area 4·2000 sq. ins.	Area 4·4301 sq. ins.	Area 4·6664 sq. ins.	Area 4·9087 sq. ins.	Area 5·1572 sq. ins.	Area 5·4119 sq. ins.	Area 5·6727 sq. ins.
	Diam. $2\frac{3}{16}$ inches.	Diam. $2\frac{1}{4}$ inches.	Diam. $2\frac{5}{16}$ inches.	Diam. $2\frac{3}{8}$ inches.	Diam. $2\frac{7}{16}$ inches.	Diam. $2\frac{1}{2}$ inches.	Diam. $2\frac{9}{16}$ inches.	Diam $2\frac{5}{8}$ inches.	Diam. $2\frac{11}{16}$ inches
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	939·5	994·0	...	...	...	...	...	...	...
25	751·6	795·2	840·0	886·0	933·2	981·7	...	...	...
30	626·3	662·6	700·0	738·3	777·7	818·1	859·5	901·9	945·4
35	536·9	568·0	600·0	632·8	666·6	701·2	736·7	773·1	810·3
40	469·7	497·0	525·0	553·7	583·3	613·5	644·6	676·4	709·0
45	417·5	441·7	466·6	492·2	518·4	545·4	573·0	601·3	630·3
50	375·8	397·6	420·0	443·0	466·6	490·8	515·7	541·1	567·2
55	341·6	361·4	381·8	402·7	424·2	446·2	468·8	491·9	515·7
60	313·1	331·3	350·0	369·1	388·8	409·0	429·7	450·9	472·7
65	289·0	305·8	323·0	340·7	358·9	377·5	396·7	416·3	436·3
70	268·4	284·0	300·0	316·4	333·3	350·6	368·3	386·5	405·1
75	250·5	265·0	280·0	295·3	311·0	327·2	343·8	360·7	378·1
80	234·8	248·5	262·5	276·8	291·6	306·7	322·3	338·2	354·5
85	221·0	233·8	247·0	260·6	274·4	288·7	303·3	318·3	333·6
90	208·7	220·8	233·3	246·1	259·2	272·7	286·5	300·6	315·1
95	197·8	209·2	221·0	233·1	245·6	258·3	271·4	284·8	298·5
100	187·9	198·8	210·0	221·5	233·3	245·4	257·8	270·5	283·6
105	178·9	189·3	200·0	210·9	222·2	233·7	245·5	257·7	270·1
110	170·8	180·7	190·9	201·3	212·1	223·1	234·4	245·9	257·[illegible]
115	163·4	172·8	182·6	192·6	202·8	213·4	224·2	235·3	24[illegible]
120	156·5	165·6	175·0	184·5	194·4	204·5	214·8	225·4	23[illegible]
125	150·3	159·0	168·0	177·2	186·6	196·3	206·2	216·4	22[illegible]
130	144·5	152·9	161·5	170·3	179·4	188·7	198·3	208·1	21[illegible]
135	139·1	147·2	155·5	164·0	172·8	181·8	191·0	200·4	21[illegible]
140	134·2	142·0	150·0	158·2	166·6	175·3	184·1	193·2	20[illegible]
145	129·5	137·1	144·8	152·7	160·9	169·2	177·8	186·6	195[illegible]
150	125·2	132·5	140·0	147·6	155·5	163·6	171·9	180·3	189[illegible]
155	121·2	128·2	135·4	142·9	150·5	158·3	166·3	174·5	182[illegible]
160	117·4	124·2	131·2	138·4	145·8	153·3	161·1	169·1	177[illegible]

* 5000 lbs. per square inch of net section is the greatest working *stress to which iron* stays, which have been welded or worked in the *fire, should be subjected.*

PRESSURES, [illegible] SURFACES, [illegible] Table [illegible]

Stress on Iron Stays [illegible] per square inch of net section.*

Pressure per square inch.	[illegible] sq. ins.	[illegible] sq. ins.	[illegible] sq. ins.	[illegible] sq. ins.	[illegible] sq. ins.	[illegible] sq. ins.	[illegible] sq. ins.	[illegible] sq. ins.	[illegible] sq. ins.
	Diam. [illegible] inches.	Diam. [illegible] inches.	Diam. [illegible] inches.	Diam. [illegible] inches.	Diam. [illegible] inches.	Diam. [illegible] inches.	Diam. [illegible] inches.	Diam. [illegible] inches.	Diam. [illegible] inches.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	..	..	..	..	..	..	..	..	..
10	...	...	..	..	..	..	..	..	..
15	...	...	..	..	..	..	..	..	...
20	...	...	..	..	..	..	..	..	..
25	...	...	..	..	..	..	..	..	.
30	989·9	.	..	..	..	..	..	..	.
5	844·5	[illegible]	[illegible]	[illegible]		.	.	.	.
0	7[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.
5	659·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	593·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	539·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	494·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	456·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	424·2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	395·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	371·2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	349·3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	329·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	312·3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	282·5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	269·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	258·2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	247·4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	237·5	249·5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	228·4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	219·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	212·1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	197·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	191·5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	185·8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* 5000 lbs. per square [illegible]
ress to which iron stays [illegible]
, should be subjected.

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

Stress on *Solid* Iron Screwed Stays, which have *not* been welded or worked in the fire, 7000 lbs. per square inch of net section.

The following notes will facilitate the use of the Tables which immediately follow, numbered 36 to 40 :—

(1) If the working pressure be 140 lbs., the surface to be supported by one stay 210 square inches, and the size of stay be required :—

Then, opposite 140 lbs. in Table No. 39, the surface 210 square inches is found under the diameter $2\frac{5}{16}$ inches and area 4·2 square inches, which is the size of stay required.

(2) If the surface be 138 square inches, the stay $1\frac{7}{8}$ inch diameter, area 2·7612 square inches, and the working pressure be required :—

Then, in Table No. 38, $1\frac{7}{8}$ diameter stay is found, and in the column under the area 2·7612 square inches, and $1\frac{7}{8}$ inch diameter, the surface is 138 square inches, and opposite it the pressure is 140 lbs. ; this is the working pressure suitable.

(3) If the stay be 1 inch diameter, the area ·7854 square inch, the working pressure 80 lbs., and the greatest surface for such size of stay and working pressure be required :—

Then, in Table No. 36, 1 inch stay is found, and opposite 80 lbs. in the column for 1 inch diameter, area ·7854 inch, the surface is 68·7 square inches; this is the surface suitable for such stay and pressure.

When the surface is not found opposite the pressure, it will be on the side of safety to adopt the larger size of stay over the next greater surface on the right.

The diameter is always the net effective diameter, or diameter at the bottom of the thread, and the area the net sectional area at the smallest part of the stay.

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

TABLE No. 36.

Stress on *Solid* Iron Screwed Stays, which have *not* been welded or worked in the fire, 7000 lbs. per square inch of net section.*

Pressure per square inch.	Area 0·1963 sq. inch.	Area 0·2485 sq. inch.	Area 0·3068 sq. inch.	Area 0·3712 sq. inch.	Area 0·4417 sq. inch.	Area 0·5184 sq. inch.	Area 0·6013 sq. inch.	Area 0·6902 sq. inch.	Area 0·7854 sq. inch.
	Diam. ½ inch.	Diam. 9/16 inch.	Diam. ⅝ inch.	Diam. 11/16 inch.	Diam. ¾ inch.	Diam. 13/16 inch.	Diam. ⅞ inch.	Diam. 15/16 inch.	Diam. 1 inch.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	274·8	347·9	429·5	519·6	618·3	725·7	841·8	966·2	...
10	137·4	173·9	214·7	259·8	309·1	362·8	420·9	483·1	549·7
15	91·6	115·9	143·1	173·2	206·1	241·9	280·6	322·0	366·5
20	68·7	86·9	107·3	129·9	154·5	181·4	210·4	241·5	274·8
25	54·9	69·5	85·9	103·9	123·6	145·1	168·3	193·2	219·9
30	45·8	57·9	71·5	86·6	103·0	120·9	140·3	161·0	183·2
35	39·2	49·7	61·3	74·2	88·3	103·6	120·2	138·0	157·0
40	34·3	43·4	53·6	64·9	77·2	90·7	105·2	120·7	137·4
45	30·5	38·6	47·7	57·7	68·7	80·6	93·5	107·3	122·1
50	27·4	34·7	42·9	51·9	61·8	72·5	84·1	96·6	109·9
55	24·9	31·6	39·0	47·2	56·2	65·9	76·5	87·8	99·9
60	22·9	28·9	35·7	43·3	51·5	60·4	70·1	80·5	91·6
65	21·1	26·7	33·0	39·9	47·5	55·8	64·7	74·3	84·5
70	19·6	24·8	30·6	37·1	44·1	51·8	60·1	69·0	78·5
75	18·3	23·1	28·6	34·6	41·2	48·3	56·1	64·4	73·3
80	17·1	21·7	26·8	32·4	38·6	45·3	52·6	60·4	68·7
85	16·1	20·4	25·2	30·5	36·3	42·7	49·5	56·8	64·6
90	15·2	19·3	23·8	28·8	34·3	40·3	46·7	53·6	61·0
95	14·4	18·3	22·6	27·3	32·5	38·2	44·3	50·8	57·8
100	13·7	17·3	21·4	25·9	30·9	36·2	42·0	48·3	54·9
105	13·0	16·5	20·4	24·7	29·4	34·5	40·0	46·0	52·3
110	12·4	15·8	19·5	23·6	28·1	32·9	38·2	43·9	49·9
115	...	15·1	18·6	22·5	26·8	31·5	36·6	42·0	47·8
120	...	14·4	17·8	21·6	25·7	30·2	35·0	40·2	45·8
125	...	13·9	17·1	20·7	24·7	29·0	33·6	38·6	43·9
130	...	13·3	16·5	19·9	23·7	27·9	32·3	37·1	42·2
135	...	12·8	15·9	19·2	22·9	26·8	31·1	35·7	40·7
140	...	12·4	15·3	18·5	22·0	25·9	30·0	34·5	39·2
145	...	...	14·8	17·9	21·3	25·0	29·0	33·3	37·9
150	...	...	14·3	17·3	20·6	24·1	28·0	32·2	36·6
155	...	...	13·8	16·7	19·9	23·4	27·1	31·1	35·4
160	...	...	13·4	16·2	19·3	22·6	26·3	30·2	34·3

* 7000 lbs. per square inch of net section is the greatest working stress to which *solid* iron screwed stays, which have *not* been welded *or worked in the fire*, should be subjected.

Stress on *Solid* Iron Screwed Stays, which have *not* been welded or worked in the fire, 7000 lbs. per square inch of net section.*

Pressure per square inch.	Area 0·8866 sq. inch.	Area 0·9940 sq. inch.	Area 1·1075 sq. inch.	Area 1·2272 sq. inch.	Area 1·3530 sq. inch.	Area 1·4849 sq. inch	Area 1·6230 sq. inch.	Area 1·7671 sq. inch.	Area 1·9175 sq. inch.
	Diam. 1$\frac{1}{16}$ inch.	Diam. 1$\frac{1}{8}$ inch.	Diam. 1$\frac{3}{16}$ inch.	Diam. 1$\frac{1}{4}$ inch.	Diam. 1$\frac{5}{16}$ inch.	Diam. 1$\frac{3}{8}$ inch.	Diam. 1$\frac{7}{16}$ inch.	Diam. 1$\frac{1}{2}$ inch.	Diam. 1$\frac{9}{16}$ inch.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	...	...	...	...	...	...	...	...	...
10	620·6	695·8	775·2	859·0	947·0	...	...	...	...
15	413·7	463·8	516·8	572·6	631·3	692·9	757·4	824·6	894·8
20	310·3	347·9	387·6	429·5	473·5	519·7	568·0	618·4	671·1
25	248·2	278·3	310·1	343·6	378·8	415·7	454·4	494·7	536·9
30	206·8	231·9	258·4	286·3	315·6	346·4	378·7	412·3	447·4
35	177·3	198·8	221·5	245·4	270·5	296·9	324·6	353·4	383·5
40	155·1	173·9	193·8	214·7	236·7	259·8	284·0	309·2	335·5
45	137·9	154·6	172·2	190·8	210·4	230·9	252·4	274·8	298·2
50	124·1	139·1	155·0	171·8	189·4	207·8	227·2	247·3	268·4
55	112·8	126·5	140·9	156·1	172·1	188·9	206·5	224·9	244·0
60	103·4	115·9	129·2	143·1	157·8	173·2	189·3	206·1	223·7
65	95·4	107·0	119·2	132·1	145·6	159·9	174·7	190·3	206·5
70	88·6	99·4	110·7	122·7	135·2	148·4	162·2	176·7	191·7
75	82·7	92·7	103·3	114·5	126·2	138·5	151·4	164·9	178·9
80	77·5	86·9	96·9	107·3	118·3	129·9	142·0	154·6	167·7
85	73·0	81·8	91·2	101·0	111·4	122·2	133·6	145·5	157·9
90	68·9	77·3	86·1	95·4	105·2	115·4	126·2	137·4	149·1
95	65·3	73·2	81·6	90·4	99·6	109·4	119·5	130·2	141·2
100	62·0	69·5	77·5	85·9	94·7	103·9	113·6	123·6	134·2
105	59·1	66·2	73·8	81·8	90·1	98·9	108·1	117·8	127·8
110	56·4	63·2	70·4	78·0	86·0	94·4	103·2	112·4	122·0
115	53·9	60·5	67·4	74·6	82·3	90·3	98·7	107·5	116·7
120	51·7	57·9	64·6	71·5	78·9	86·6	94·6	103·0	111·8
125	49·6	55·6	62·0	68·7	75·7	83·1	90·8	98·9	107·3
130	47·7	53·5	59·6	66·0	72·8	79·9	87·3	95·1	103·2
135	45·9	51·5	57·5	63·6	70·1	76·9	84·1	91·6	99·4
140	44·3	49·7	55·3	61·3	67·6	74·2	81·1	88·3	95·8
145	42·8	47·9	53·4	59·2	65·3	71·6	78·3	85·3	92·5
150	41·3	46·3	51·6	57·2	63·1	69·2	75·7	82·4	89·4
155	40·0	44·8	50·0	55·4	61·0	67·0	73·2	79·8	86·5
160	38·7	43·4	48·4	53·6	59·1	64·9	71·0	77·3	83·8

* 7000 lbs. per square inch of net section is the greatest working stress to which *solid* iron screwed stays, which have *not* been welded *or worked in the fire*, should be subjected.

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

TABLE No. 38.

Stress on *Solid* Iron Screwed Stays, which have *not* been welded or worked in the fire, 7000 lbs. per square inch of net section.*

Pressure per square inch.	Area 2·0739 sq. ins.	Area 2·2365 sq. ins.	Area 2·4053 sq. ins.	Area 2·5802 sq. ins.	Area 2·7612 sq. ins.	Area 2·9483 sq. ins.	Area 3·1416 sq. ins.	Area 3·3410 sq. ins.	Area 3·5466 sq. ins.
	Diam. 1 5/8 inch.	Diam. 1 11/16 inch.	Diam. 1 3/4 inch.	Diam. 1 13/16 inch.	Diam. 1 7/8 inch.	Diam. 1 15/16 inch.	Diam. 2 inches.	Diam. 1/16 inches.	Diam. 2 1/8 inches.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	967·8	...	...	...	...	...	...	...	...
20	725·8	782·7	841·8	903·0	966·4	...	...	...	...
25	580·6	626·2	673·4	722·4	773·1	825·5	879·6	935·4	993·0
30	483·9	521·8	561·2	602·0	644·2	687·9	733·0	779·5	827·5
35	414·7	447·3	481·0	516·0	552·2	589·6	628·3	668·2	709·3
40	362·9	391·3	420·9	451·5	483·2	515·9	549·7	584·6	620·6
45	322·6	347·9	374·1	401·3	429·5	458·6	488·6	519·7	551·6
50	290·3	313·1	336·7	361·2	386·5	412·7	439·8	467·7	496·5
55	263·9	284·6	306·1	328·3	351·4	375·2	399·8	425·2	451·3
60	241·9	260·9	280·6	301·0	322·1	343·9	366·5	389·7	413·7
65	223·3	240·8	259·0	277·8	297·3	317·5	338·3	359·8	381·9
70	207·3	223·6	240·5	258·0	276·1	294·8	314·1	334·1	354·6
75	193·5	208·7	224·4	240·8	257·7	275·1	293·2	311·8	331·0
80	181·4	195·6	210·4	225·7	241·6	257·9	274·8	292·3	310·3
85	170·7	184·1	198·0	212·4	227·3	242·8	258·7	275·1	292·0
90	161·3	173·9	187·0	200·6	214·7	229·3	244·3	259·8	275·8
95	152·8	164·7	177·2	190·1	203·4	217·2	231·4	246·1	261·3
100	145·1	156·5	168·3	180·6	193·2	206·3	219·9	233·8	248·2
105	138·2	149·1	160·3	172·0	184·0	196·5	209·4	222·7	236·4
110	131·9	142·3	153·0	164·1	175·7	187·6	199·9	212·6	225·6
115	126·2	136·1	146·4	157·0	168·0	179·4	191·2	203·3	215·8
120	120·9	130·4	140·3	150·5	161·0	171·9	183·2	194·8	206·8
125	116·1	125·2	134·6	144·4	154·6	165·1	175·9	187·1	198·6
130	111·6	120·4	129·5	138·9	148·6	158·7	169·1	179·9	190·9
135	107·5	115·9	124·7	133·7	143·1	152·8	162·8	173·2	183·8
140	103·6	111·8	120·2	129·0	138·0	147·4	157·0	167·0	177·3
145	100·1	107·9	116·1	124·5	133·2	142·3	151·6	161·2	171·2
150	96·7	104·3	112·2	120·4	128·8	137·5	146·6	155·9	165·5
155	93·6	101·0	108·6	116·5	124·6	131·1	141·8	150·8	160·1
160	90·7	97·8	105·2	112·8	120·7	128·9	137·4	146·1	155·1

* 7000 lbs. per square inch of net section is the greatest working stress to which *solid iron* screwed stays, which have *not* been welded *or worked in the fire*, should be subjected.

Stress on *Solid* Iron Screwed Stays, which have *not* been welded or worked in the fire, 7000 lbs. per square inch of net section.*

Pressure per square inch.	Area 3·7583 sq. ins.	Area 3·9761 sq. ins.	Area 4·2000 sq. ins.	Area 4·4301 sq. ins.	Area 4·6664 sq. ins.	Area 4·9087 sq. ins.	Area 5·1572 sq. ins.	Area 5·4119 sq. ins.	Area 5·6727 sq. ins.
	Diam. $2\frac{3}{16}$ inches.	Diam. $2\frac{1}{4}$ inches.	Diam. $2\frac{5}{16}$ inches.	Diam. $2\frac{3}{8}$ inches.	Diam. $2\frac{7}{16}$ inches.	Diam. $2\frac{1}{2}$ inches.	Diam. $2\frac{9}{16}$ inches.	Diam. $2\frac{5}{8}$ inches.	Diam. $2\frac{11}{16}$ inches.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	876·9	927·7	980·0	...	...	...	...	...	...
35	751·6	795·2	840·0	886·0	933·2	981·7	...	...	...
40	657·7	695·8	735·0	775·2	816·6	859·0	902·5	947·0	992·7
45	584·6	618·4	653·3	689·1	725·8	763·5	802·2	841·8	882·4
50	526·1	556·6	588·0	620·2	653·2	687·2	722·0	757·6	794·1
55	478·3	506·0	534·5	563·8	593·9	624·7	656·3	688·7	721·9
60	438·4	463·8	490·0	516·8	544·4	572·6	601·6	631·3	661·8
65	404·7	428·1	452·3	477·0	502·5	528·6	555·3	582·8	610·9
70	375·8	397·6	420·0	443·0	466·6	490·8	515·7	541·1	567·2
75	350·7	371·0	392·0	413·4	435·5	458·1	481·3	505·1	529·4
80	328·8	347·9	367·5	387·6	408·3	429·5	451·2	473·5	496·3
85	309·4	327·4	345·8	364·8	384·2	404·2	424·7	445·6	467·1
90	292·3	309·2	326·6	344·5	362·9	381·7	401·1	420·9	441·2
95	276·9	292·9	309·4	326·4	343·8	361·6	380·0	398·7	417·9
100	263·0	278·3	294·0	310·1	326·6	343·6	361·0	378·8	397·0
105	250·5	265·0	280·0	295·3	311·0	327·2	343·8	360·7	378·1
110	239·1	253·0	267·2	281·9	296·9	312·3	328·1	344·3	360·9
115	228·7	242·0	255·6	269·6	284·0	298·7	313·9	329·4	345·2
120	219·2	231·9	245·0	258·4	272·2	286·3	300·8	315·6	330·9
125	210·4	222·6	235·2	248·0	261·3	274·8	288·8	303·0	317·6
130	202·3	214·0	226·1	238·5	251·2	264·3	277·7	291·4	305·4
135	194·8	206·1	217·7	229·7	241·9	254·5	267·4	280·6	294·1
140	187·9	198·8	210·0	221·5	233·3	245·4	257·8	270·5	283·6
145	181·4	191·9	202·7	213·8	225·2	236·9	248·9	261·2	273·8
150	175·3	185·5	196·0	206·7	217·7	229·0	240·6	252·5	264·7
155	169·7	179·5	189·6	200·0	210·7	221·6	232·9	244·4	256·1
160	164·4	173·9	183·7	193·8	204·1	214·7	220·6	236·7	248·1

* 7000 lbs. per square inch of net section is the greatest working stress to which *solid* iron screwed stays, which have *not* been welded *or worked in the fire*, should be subjected.

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

Table No. 40.

Stress on *Solid* Iron Screwed Stays, which have *not* been welded or worked in the fire, 7000 lbs. per square inch of net section.*

Pressure per square inch.	Area 5·9396 sq. ins.	Area 6·2126 sq. ins.	Area 6·4918 sq. ins.	Area 6·7771 sq. ins.	Area 7·0686 sq. ins.	Area 7·3662 sq. ins.	Area 7·6699 sq. ins.	Area 7·9798 sq. ins.	Area 8·2958 sq. ins.
	Diam. 2¾ inches.	Diam. 2 13/16 inches.	Diam. 2⅞ inches.	Diam. 2 15/16 inches.	Diam. 3 inches.	Diam. 3 1/16 inches.	Diam. 3⅛ inches.	Diam. 3 5/16 inches.	Diam. 3¼ inches.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...
45	923·9	966·4	...	...	...	...	...	...	...
50	831·5	869·7	908·8	948·8	989·6	...	...	...	...
55	755·9	790·6	826·2	862·5	899·6	937·5	976·1	...	...
60	692·9	724·8	757·3	790·6	824·6	859·3	894·8	930·9	967·8
65	639·6	669·0	699·1	729·8	761·2	793·2	825·9	859·3	893·3
70	593·9	621·2	649·1	677·7	706·8	736·6	766·9	797·9	829·5
75	554·3	579·8	605·9	632·5	659·7	687·5	715·8	744·7	774·2
80	519·7	543·6	568·0	593·0	618·5	644·5	671·1	698·2	725·8
85	489·1	511·6	534·6	558·1	582·1	606·6	631·6	657·1	683·1
90	461·9	483·2	504·9	527·1	549·7	572·9	596·5	620·6	645·2
95	437·6	457·7	478·3	499·3	520·8	542·7	565·1	587·9	611·2
100	415·7	434·8	454·4	474·4	494·8	515·6	536·8	558·5	580·7
105	395·9	414·1	432·7	451·8	471·2	491·0	511·2	531·9	553·0
110	377·9	395·3	413·1	431·2	449·8	468·7	488·0	507·7	527·9
115	361·5	378·1	395·1	412·5	430·2	448·3	466·8	485·7	504·9
120	346·4	362·4	378·6	395·3	412·3	429·6	447·4	465·4	483·9
125	332·6	347·9	363·5	379·5	395·8	412·5	429·5	446·8	464·5
130	319·8	334·5	349·5	364·9	380·6	396·6	412·9	429·6	446·6
135	307·9	322·1	336·6	351·4	366·5	381·9	397·6	413·7	430·1
140	296·9	310·6	324·5	338·8	353·4	368·3	383·4	398·9	414·7
145	286·7	299·9	313·3	327·1	341·2	355·6	370·2	385·2	400·4
150	277·1	289·9	302·9	316·2	329·8	343·7	357·9	372·3	387·1
155	268·2	280·5	293·1	306·0	319·2	332·6	346·3	360·3	374·6
160	259·8	271·8	284·0	296·5	309·7	322·2	335·5	349·1	362·9

* 7000 lbs. per square inch of net section is the greatest working stress to which *solid* iron screwed stays, which have not been welded or worked in the fire, should be subjected.

IRON GIRDERS FOR FLAT SURFACES.

The following notes will facilitate the use of the Tables, numbered from 41 to 51, which immediately follow :—

W = Width of combustion box, in inches.
D = Distance between centres of girders, in inches.
P = Pitch of supporting bolts, in inches.
N = Number of supporting bolts in a girder.

When the number of supporting bolts in a girder is *odd*, the number in the Table under the particular depth of girder is the maximum value that $W^2 \times D$ may have for the particular working pressure opposite to it in column 1.

When the number of supporting bolts in a girder is *even*, the number in the Table under the particular depth of girder is the maximum value that $(W^2 - P^2)D$ may have for the particular working pressure opposite to it in column 1.

(1) If the working pressure is required when the width of the box, the distance between centres of girders, the pitch of supporting bolts, the number of supporting bolts in the girder, and the dimensions of girder are known :—

If the width, W, of the combustion box be 28 inches, the number, N, of bolts 3 (which is an *odd* number), the distance, D, between the centres of the girders 7 inches, and the dimensions of the girder 6 inches deep by 1 inch thick :—

Then, $W^2 \times D$ or $28^2 \times 7 = 5488$. This number is not found in the Table, it being between 5400 and 5760 (see Table No. 45 for Iron Plates 1 inch thick), but by the note at the foot of the Tables, when the exact number is not found, the next *higher* number should be taken ; hence the pressure opposite 5760, the next *higher* number, being 75 lbs., is the working pressure obtained. When the difference is very little, however, as it is in this case, between 5488 and 5400, the pressure opposite the *lower* number may be used ; therefore, 80 lbs. may be adopted as the working pressure.

(2) When the depth of girder necessary for a given working pressure and thickness of girder is required :—

If the width, W, of the combustion box be 24 inches, the number, N, of supporting bolts 2 (which is an *even* number), the distance, D, between the centres of the girders $8\frac{3}{4}$ inches, the pitch of the supporting bolts 8 inches, the thickness of the girders 1 inch, and the working pressure 80 lbs. :—

Then, $(W^2 - P^2)D$ or $(24^2 - 8^2)\ 8\frac{3}{4} = 4480$ and opposite 80 lbs. working pressure in column 1, the number 4537 is found (see *Table No.* 45 for Iron Plates 1 inch thick), which is the next

greater number to 4460, and at the head of column over 4587 will be found $5\frac{1}{4}$ inches, the depth of girder necessary.

P may in all cases be found by dividing W, the width of the combustion box, by N, the number of supporting bolts in the girder, *plus* 1, or $\frac{W}{N+1} = P$ in all cases.

D, when the number of supporting bolts is *odd*, may be found by dividing the number in the Table opposite the given working pressure by W^2.

When the number of supporting bolts is *even*, D can be found by dividing the number in the Table opposite the given working pressure by $W^2 - P^2$.

The working pressure and the thickness of plate regulate P, the pitch, and D, the distance between the centres of girders; and the surface due to $P \times D$ should be regulated by the Tables for Iron Plates (Pitches, Surfaces, and Pressures). The girders should be so proportioned as to be effective for the pressure, pitch of supporting bolts, number of supporting bolts in a girder, and the distance between the centres of girders. By the following Tables the dimensions of iron girders can be fixed, or the working pressure suitable for any given wrought iron girder ascertained.

Pressure per sq. in.	Depths of Girders in inches.							
	1¾	2	2¼	2½	2¾	3	3¼	3½
lbs. 5	3675	4800	6075	7500	9075	10800	12675	1470
10	1837	2400	3037	3750	4537	5400	6337	735
15	1225	1600	2025	2500	3025	3600	4225	490
20	918	1200	1518	1875	2268	2700	3168	367
25	735	960	1215	1500	1815	2160	2535	294
30	612	800	1012	1250	1512	1800	2112	245
35	525	685	867	1071	1296	1542	1810	210
40	...	600	759	937	1134	1350	1584	183
45	...	533	675	833	1008	1200	1408	163
50	...	...	607	750	907	1080	1267	147
55	...	...	552	681	825	981	1152	133
60	...	...	506	625	756	900	1056	122
65	...	...	...	576	698	830	975	113
70	...	...	...	535	648	771	905	105
75	...	...	...	500	605	720	845	98
80	...	...	...	...	567	675	792	91
85	...	...	...	...	533	635	745	86
90	...	...	...	...	504	600	704	81
95	...	...	...	...	...	568	667	77
100	...	...	...	...	...	540	633	73
105	...	...	...	...	...	514	603	70
110	...	...	...	...	...	...	576	66
115	...	...	...	...	...	...	551	63
120	...	...	...	...	...	...	528	61
125	...	...	...	...	...	...	507	58
130	...	...	...	...	...	...	...	56
135	...	...	...	...	...	...	...	54
140	...	...	...	...	...	...	...	52
145	...	...	...	...	...	...	...	50
150	...	...	...	...	...	...	...	...
155	...	...	...	...	...	...	...	...
160	...	...	...	...	..	...	...	...

In the above Table, when the number of supporting b girder is *odd*, the number under the particular depth of gird W^2D; but when the number of bolts is *even*, it equals (W When the exact value or number is not found under the give the next greater number in the same column is the number, which will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = *Pitch* of supporting bolts in inches.

	Depths of Girders in inches.								
	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼
5	7593	9375	11343	13500	15843	18375	21093	24000	27093
0	3796	4687	5671	6750	7921	9187	10546	12000	13546
5	2531	3125	3781	4500	5281	6125	7031	8000	9031
0	1898	2343	2835	3375	3960	4593	5273	6000	6773
5	1518	1875	2268	2700	3168	3675	4218	4800	5418
0	1265	1562	1890	2250	2640	3062	3515	4000	4515
5	1084	1339	1620	1928	2263	2625	3013	3428	3870
0	949	1171	1417	1687	1980	2296	2636	3000	3386
5	843	1041	1260	1500	1760	2041	2343	2666	3010
0	759	937	1134	1350	1584	1837	2109	2400	2709
5	690	852	1031	1227	1440	1670	1917	2181	2463
0	632	781	945	1125	1320	1531	1757	2000	2257
5	584	721	872	1038	1218	1413	1622	1846	2084
0	542	669	810	964	1131	1312	1506	1714	1935
5	506	625	756	900	1056	1225	1406	1600	1806
0	...	585	708	843	990	1148	1318	1500	1693
5	...	551	667	794	931	1080	1240	1411	1593
0	...	520	630	750	880	1020	1171	1333	1505
5	...	...	597	710	833	967	1110	1263	1425
0	...	...	567	675	792	918	1054	1200	1354
5	...	...	540	642	754	875	1004	1142	1290
10	...	...	515	613	720	835	958	1090	1231
15	...	...	...	586	688	798	917	1043	1177
20	...	...	...	562	660	765	878	1000	1128
25	...	...	...	540	633	735	843	960	1083
30	...	...	...	519	609	706	811	923	1042
35	...	...	...	500	586	680	781	888	1003
40	...	...	...	...	565	656	753	857	967
45	...	...	...	...	546	633	727	827	934
50	...	...	...	...	528	612	703	800	903
55	...	...	...	...	511	592	680	774	873
60	...	...	...	...	...	574	659	750	846

In the above Table, when the number of supporting bolts in a irder is *odd*, the number under the particular depth of girder equals W^2D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. When the exact value or number is not found under the given depth, he next greater number in the same column is the number, opposite hich will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = *Pitch of supporting* bolts in inches.

Pressure per sq. in.	Depths of Girders in inches.							
	2¾	3	3¼	3½	3¾	4	4¼	4½
lbs. 5	13612	16200	19012	22050	25312	28800	32512	36450	40
10	6806	8100	9506	11025	12656	14400	16256	18225	20
15	4537	5400	6337	7350	8437	9600	10837	12150	13
20	3403	4050	4753	5512	6328	7200	8128	9112	10
25	2722	3240	3802	4410	5062	5760	6502	7290	8
30	2268	2700	3168	3675	4218	4800	5418	6075	6
35	1944	2314	2716	3150	3616	4114	4644	5207	5
40	1701	2025	2376	2756	3164	3600	4064	4556	5
45	1512	1800	2112	2450	2812	3200	3612	4050	4
50	1361	1620	1901	2205	2531	2880	3251	3645	4
55	1237	1472	1728	2004	2301	2618	2955	3313	3
60	1134	1350	1584	1837	2109	2400	2709	3037	3
65	1047	1246	1462	1696	1947	2215	2500	2803	3
70	972	1157	1358	1575	1808	2057	2322	2603	2
75	907	1080	1267	1470	1687	1920	2167	2430	2
80	850	1012	1188	1378	1582	1800	2032	2278	2
85	800	952	1118	1297	1488	1694	1912	2144	2
90	756	900	1056	1225	1406	1600	1806	2025	2
95	716	852	1000	1160	1332	1515	1711	1918	2
100	680	810	950	1102	1265	1440	1625	1822	2
105	648	771	905	1050	1205	1371	1548	1735	1
110	618	736	864	1002	1150	1309	1477	1656	1
115	591	704	826	958	1100	1252	1413	1584	1
120	567	675	792	918	1054	1200	1354	1518	1
125	544	648	760	882	1012	1152	1300	1458	1
130	523	623	731	848	973	1107	1250	1401	1
135	504	600	704	816	937	1066	1204	1350	1
140	...	578	679	787	904	1028	1161	1301	1
145	...	558	655	760	872	993	1121	1256	1
150	...	540	633	735	843	960	1083	1215	1
155	...	522	613	711	816	929	1048	1175	1
160	...	506	594	689	791	900	1016	1139	1

In the above Table, when the number of supporting bolts girder is *odd*, the number under the particular depth of girder eq W^2D; but when the number of bolts is *even*, it equals ($W^2 -$ P When the exact value or number is not found under the given de the next greater number in the same column is the number, opp which will be found the working pressure in column 1.

W = Width of combustion box in inches.

D = Distance between centres of girders in inches.

P = *Pitch* of supporting bolts in inches.

	Depths of Girders in inches.								
	3½	3¾	4	4¼	4½	4¾	5	5¼	5½
5	25725	29531	33600	37931	42525	47381	...	...	...
0	12862	14765	16800	18965	21262	23690	26250	28940	31762
5	8575	9843	11200	12643	14175	15793	17500	19293	21175
0	6431	7382	8400	9482	10631	11845	13125	14470	15881
5	5145	5906	6720	7586	8505	9476	10500	11576	12705
0	4287	4921	5600	6321	7087	7896	8750	9646	10587
5	3675	4218	4800	5418	6075	6768	7500	8268	9075
0	3215	3691	4200	4741	5315	5922	6562	7235	7940
5	2858	3281	3733	4214	4725	5264	5833	6431	7058
0	2572	2953	3360	3793	4252	4738	5250	5788	6352
5	2338	2684	3054	3448	3865	4307	4772	5261	5775
0	2143	2460	2800	3160	3543	3948	4375	4823	5293
5	1978	2271	2584	2917	3271	3644	4038	4452	4886
0	1837	2109	2400	2709	3037	3384	3750	4134	4537
5	1715	1968	2240	2528	2835	3158	3500	3858	4235
0	1607	1845	2100	2370	2657	2961	3281	3617	3970
5	1513	1737	1976	2231	2501	2787	3088	3404	3736
0	1429	1640	1866	2107	2362	2632	2916	3215	3529
5	1353	1554	1768	1996	2238	2493	2763	3046	3343
0	1286	1476	1680	1896	2126	2369	2625	2894	3176
5	1225	1406	1600	1806	2025	2256	2500	2756	3025
0	1169	1342	1527	1724	1932	2153	2386	2630	2887
5	1118	1283	1460	1649	1848	2060	2282	2516	2761
0	1071	1230	1400	1580	1771	1974	2187	2411	2646
5	1029	1181	1344	1517	1701	1895	2100	2315	2541
0	989	1135	1292	1458	1635	1822	2019	2226	2443
5	952	1093	1244	1404	1575	1754	1944	2143	2352
0	918	1054	1200	1354	1518	1692	1875	2067	2268
5	887	1018	1158	1307	1466	1633	1810	1995	2190
0	857	984	1120	1264	1417	1579	1750	1929	2117
5	829	952	1083	1223	1371	1528	1693	1867	2049
0	803	922	1050	1185	1328	1480	1640	1808	1985

In the above Table, when the number of supporting bolts in a der is *odd*, the number under the particular depth of girder equals ^{2}D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. hen the exact value or number is not found under the given depth, e next greater number in the same column is the number, opposite ich will be found the working pressure in column 1.

W = Width of combustion box in inches.

D = Distance between centres of girders in inches.

P = Pitch of supporting bolts in inches.

Pressure per sq. in.	Depths of Girders in inches.								
	4¼	4½	4¾	5	5¼	5½	5¾	6	6¼
lbs. 5	43350	48600	...	...	...	...	...	...	...
10	21675	24300	27075	30000	33075	36300	39675	43200	46875
15	14450	16200	18050	20000	22050	24200	26450	28800	31250
20	10837	12150	13537	15000	16537	18150	19837	21600	23437
25	8670	9720	10830	12000	13230	14520	15870	17280	18750
30	7225	8100	9025	10000	11025	12100	13225	14400	15625
35	6192	6942	7735	8571	9450	10371	11335	12342	13392
40	5418	6075	6768	7500	8268	9075	9918	10800	11718
45	4816	5400	6016	6666	7350	8066	8816	9600	10416
50	4335	4860	5415	6000	6615	7260	7935	8640	9375
55	3940	4418	4922	5454	6013	6600	7213	7854	8522
60	3612	4050	4512	5000	5512	6050	6612	7200	7812
65	3334	3738	4165	4615	5088	5584	6103	6646	7211
70	3096	3471	3867	4285	4725	5185	5667	6171	6696
75	2890	3240	3610	4000	4410	4840	5290	5760	6250
80	2709	3037	3384	3750	4134	4537	4959	5400	5859
85	2550	2858	3185	3529	3891	4270	4667	5082	551[illegible]
90	2408	2700	3008	3333	3675	4033	4408	4800	52[illegible]
95	2281	2557	2850	3157	3481	3821	4176	4547	49[illegible]
100	2167	2430	2707	3000	3307	3630	3967	4320	4[illegible]
105	2064	2314	2578	2857	3150	3457	3778	4114	4[illegible]
110	1970	2209	2461	2727	3006	3300	3606	3927	[illegible]
115	1884	2113	2354	2608	2876	3156	3450	3756	[illegible]
120	1806	2025	2256	2500	2756	3025	3306	3600	[illegible]
125	1734	1944	2166	2400	2646	2904	3174	3456	[illegible]
130	1667	1869	2082	2307	2544	2792	3051	3323	[illegible]
135	1605	1800	2005	2222	2450	2688	2938	3200	[illegible]
140	1548	1735	1933	2142	2362	2592	2833	3085	[illegible]
145	1494	1675	1867	2068	2281	2503	2736	2979	[illegible]
150	1445	1620	1805	2000	2205	2420	2645	2880	3[illegible]
155	1398	1567	1746	1935	2133	2341	2559	2787	3[illegible]
160	1354	1518	1692	1875	2067	2268	2479	2700	2[illegible]

In the above Table, when the number of supporting bolts in girder is *odd*, the number under the particular depth of girder equals W^2D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. When the exact value or number is not found under the given depth, the next greater number in the same column is the number, opposite which will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = *Pitch* of supporting bolts in inches.

IRON GIRDERS $1\frac{1}{8}$ INCH THICK. TABLE No. 46.

…per sq. in.	Depths of Girders in inches.								
…s.	5	5¼	5½	5¾	6	6¼	6½	6¾	7
5	…	…	…	…	…	…	…	…	…
0	33750	37209	40837	44634	48600	…	…	…	…
5	22500	24806	27225	29756	32400	35156	38025	41006	44100
0	16875	18604	20418	22317	24300	26367	28518	30754	33075
5	13500	14883	16335	17853	19440	21093	22815	24603	26460
0	11250	12403	13612	14878	16200	17578	19012	20503	22050
5	9642	10631	11667	12752	13885	15066	16296	17574	18900
0	8437	9302	10209	11158	12150	13183	14259	15377	16537
5	7500	8268	9075	9918	10800	11718	12675	13668	14700
0	6750	7441	8167	8926	9720	10546	11407	12301	13230
5	6136	6765	7425	8115	8836	9588	10370	11183	12027
0	5625	6201	6806	7439	8100	8789	9506	10251	11025
5	5192	5724	6282	6866	7476	8112	8775	9462	10176
0	4821	5315	5833	6376	6942	7533	8148	8787	9450
5	4500	4961	5445	5951	6480	7031	7605	8201	8820
0	4218	4651	5104	5579	6075	6591	7129	7688	8268
5	3970	4377	4804	5251	5717	6204	6710	7236	7782
0	3750	4134	4537	4959	5400	5859	6337	6834	7350
5	3552	3916	4298	4698	5115	5550	6003	6474	6963
0	3375	3720	4083	4463	4860	5273	5703	6150	6615
5	3214	3543	3889	4250	4628	5022	5432	5858	6300
0	3068	3382	3712	4057	4418	4794	5185	5591	6013
5	2934	3235	3551	3881	4226	4585	4959	5348	5752
0	2812	3100	3403	3719	4050	4394	4753	5125	5512
5	2700	2976	3267	3570	3888	4218	4563	4920	5292
0	2596	2862	3141	3433	3738	4056	4387	4731	5088
5	2500	2756	3025	3306	3600	3906	4225	4556	4900
0	2410	2657	2916	3188	3471	3766	4074	4393	4725
5	2327	2566	2816	3078	3351	3636	3933	4242	4562
0	2250	2480	2722	2975	3240	3515	3802	4100	4410
5	2177	2400	2634	2879	3135	3402	3679	3968	4267
0	2109	2325	2552	2789	3037	3295	3564	3844	4134

In the above Table, when the number of supporting bolts in a rder is *odd*, the number under the particular depth of girder equals ^{2}D; but when the number of bolts is *even*, it equals $(W^2-P^2)D$. hen the exact value or number is not found under the given depth, e next greater number in the same column is the number, opposite hich will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = Pitch of supporting bolts in inches.

Pressure per sq. in.	Depths of Girders in inches.								
	5¾	6	6¼	6½	6¾	7	7¼	7½	7¾
lbs. 5	...	...	...	...	...	...	...	...	...
10	49593	...	...	...	..	...	...	...	...
15	33062	36000	39062	42250	45562	49000	...	...	...
20	24796	27000	29296	31687	34171	36750	39421	42187	4504
25	19837	21600	23437	25350	27337	29400	31537	33750	3603
30	16531	18000	19531	21125	22781	24500	26281	28125	3003
35	14169	15428	16741	18107	19526	21000	22526	24107	2574
40	12398	13500	14648	15843	17085	18375	19710	21093	2252
45	11020	12000	13020	14083	15187	16333	17520	18750	2002
50	9918	10800	11718	12675	13668	14700	15768	16875	180
55	9017	9818	10653	11522	12426	13363	14335	15340	163
60	8265	9000	9765	10562	11390	12250	13140	14062	150
65	7629	8307	9014	9750	10514	11307	12129	12980	13
70	7084	7714	8370	9053	9763	10500	11263	12053	12
75	6612	7200	7812	8450	9112	9800	10512	11250	12
80	6199	6750	7324	7921	8542	9187	9855	10546	11
85	5834	6352	6893	7455	8040	8647	9275	9926	1
90	5510	6000	6510	7041	7593	8166	8760	9375	1
95	5220	5684	6167	6671	7194	7736	8299	8881	[illegible]
100	4959	5400	5859	6337	6834	7350	7884	8437	[illegible]
105	4723	5142	5580	6035	6508	7000	7508	8035	[illegible]
110	4508	4909	5326	5761	6213	6681	7167	7670	[illegible]
115	4312	4695	5095	5510	5942	6391	6855	7336	[illegible]
120	4132	4500	4882	5281	5695	6125	6570	7031	[illegible]
125	3967	4320	4687	5070	5467	5880	6307	6750	[illegible]
130	3814	4153	4507	4875	5257	5653	6064	6490	[illegible]
135	3673	4000	4340	4694	5062	5444	5840	6250	[illegible]
140	3542	3857	4185	4526	4881	5250	5631	6026	[illegible]
145	3420	3724	4040	4370	4713	5068	5437	5818	[illegible]
150	3306	3600	3906	4225	4556	4900	5256	5625	[illegible]
155	3199	3483	3780	4088	4409	4741	5086	5443	[illegible]
160	3099	3375	3662	3960	4271	4593	4927	5273	[illegible]

In the above Table, when the number of supporting bolts i[n] girder is *odd*, the number under the particular depth of girder equ[als] W^2D; but when the number of bolts is *even*, it equals $(W^2-P^2$[…] When the exact value or number is not found under the given dep[th] the next greater number in the same column is the number, oppo[site] which will be found the working pressure in column 1.

W = Width of combustion box in inches.

D = Distance between centres of girders in inches.

P = *Pitch* of supporting bolts in inches.

per sq. in.	Depths of Girders in inches.								
s.	6½	6¾	7	7¼	7½	7¾	8	8¼	8½
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	46475	...	...	...	...	...	...	...	...
20	34856	37589	40425	43364	46406	49551	...	...	...
25	27885	30071	32340	34691	37125	39641	42240	44921	47685
30	23237	25059	26950	28909	30937	33034	35200	37434	39737
35	19917	21479	23100	24779	26517	28315	30171	32086	34060
40	17428	18794	20212	21682	23203	24775	26400	28075	29803
45	15491	16706	17966	19272	20625	22022	23466	24956	26491
50	13942	15035	16170	17345	18562	19820	21120	22460	23842
55	12675	13668	14700	15768	16875	18018	19200	20418	21675
60	11618	12529	13475	14454	15468	16517	17600	18717	19868
65	10725	11565	12438	13342	14278	15246	16246	17277	18340
70	9958	10739	11550	12389	13258	14157	15085	16043	17030
75	9295	10023	10780	11563	12375	13213	14080	14973	15895
80	8714	9397	10106	10841	11601	12387	13200	14037	14901
85	8201	8844	9511	10203	10919	11659	12423	13212	14025
90	7745	8353	8983	9636	10312	11011	11733	12478	13245
5	7338	7913	8510	9129	9769	10431	11115	11821	12548
0	6971	7517	8085	8672	9281	9910	10560	11230	11921
5	6639	7159	7700	8259	8839	9438	10057	10695	11353
)	6337	6834	7350	7884	8437	9009	9600	10209	10837
	6061	6537	7030	7541	8070	8617	9182	9765	10366
	5809	6264	6737	7227	7734	8258	8800	9358	9934
	5577	6014	6468	6938	7425	7928	8448	8984	9537
	5362	5782	6219	6671	7139	7623	8123	8638	9170
	5163	5568	5988	6424	6875	7340	7822	8318	8830
	4979	5369	5775	6194	6629	7078	7542	8021	8515
	4807	5184	5575	5981	6400	6834	7282	7745	8221
	4647	5011	5390	5781	6187	6606	7040	7486	7947
	4497	4850	5216	5595	5987	6393	6812	7245	7691
	4357	4698	5053	5420	5800	6193	6600	7018	7450

In the above Table, when the number of supporting bolts in a der is *odd*, the number under the particular depth of girder equals ²D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. hen the exact value or number is not found under the given depth, e next greater number in the same column is the number, opposite hich will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = Pitch of supporting bolts in inches.

Pressure per sq. in.	Depths of Girders in inches.								
	7¼	7½	7¾	8	8¼	8½	8¾	9	9¼
lbs.									
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	47306	...	...	...	...	...	...	...	...
25	37845	40500	43245	46080	49005	...	...	...	...
30	31537	33750	36037	38400	40837	43350	45937	48600	...
35	27032	28928	30889	32914	35003	37157	39375	41657	440
40	23653	25312	27028	28800	30628	32512	34453	36450	38
45	21025	22500	24025	25600	27225	28900	30625	32400	34
50	18922	20250	21622	23040	24502	26010	27562	29160	30
55	17202	18409	19656	20945	22275	23645	25056	26509	2
60	15768	16875	18018	19200	20418	21675	22968	24300	2
65	14555	15576	16632	17723	18848	20007	21201	22430	2
70	13516	14464	15444	16457	17501	18578	19687	20828	2
75	12615	13500	14415	15360	16335	17340	18375	19440	2
80	11826	12656	13514	14400	15314	16256	17226	18225	1
85	11130	11911	12719	13552	14413	15300	16213	17152	1
90	10512	11250	12012	12800	13612	14450	15312	16200	1
95	9959	10657	11380	12126	12896	13689	14506	15347	1
100	9461	10125	10811	11520	12251	13005	13781	14580	1
105	9010	9642	10296	10971	11667	12385	13125	13885	1
110	8601	9204	9828	10472	11137	11822	12528	13254	1
115	8227	8804	9401	10017	10653	11308	11983	12678	1
120	7884	8437	9009	9600	10209	10837	11484	12150	1
125	7569	8100	8649	9216	9801	10404	11025	11664	1
130	7277	7788	8316	8861	9424	10003	10600	11215	11
135	7008	7500	8008	8533	9075	9633	10208	10800	11
140	6758	7232	7722	8228	8750	9289	9843	10414	11
145	6525	6982	7456	7944	8449	8968	9504	10055	10
150	6307	6750	7207	7680	8167	8670	9187	9720	10
155	6104	6532	6975	7432	7904	8390	8891	9406	9
160	5913	6328	6757	7200	7657	8128	8613	9112	96

In the above Table, when the number of supporting bolts in girder is *odd*, the number under the particular depth of girder equ W^2D; but when the number of bolts is *even*, it equals $(W^2 - P^2)$ When the exact value or number is not found under the given dept the next greater number in the same column is the number, oppos which will be found the working pressure in column 1.

W = Width of combustion box in inches.

D = Distance between centres of girders in inches.

P = *Pitch* of supporting bolts in inches.

per sq. in.	Depths of Girders in inches.								
	8	8¼	8½	8¾	9	9¼	9½	9¾	10
lbs.									
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	49920	...	...	...	...	...	...	...	...
0	41600	44240	46962	49765	...	...	...	...	...
5	35657	37920	40253	42656	45128	47670	...	...	...
	31200	33180	35221	37324	39487	41711	43996	46342	48750
	27733	29493	31308	33177	35100	37077	39108	41193	43333
	24960	26544	28177	29859	31590	33369	35197	37074	39000
	22690	24131	25615	27144	28718	30335	31997	33703	35454
	20800	22120	23481	24882	26325	27807	29331	30895	32500
	19200	20418	21675	22968	24300	25668	27075	28518	30000
	17828	18960	20126	21328	22564	23835	25141	26481	27857
	16640	17696	18785	19906	21060	22246	23465	24716	26000
	15600	16590	17610	18662	19743	20855	21998	23171	24375
	14682	15614	16575	17564	18582	19629	20704	21808	22941
	13866	14746	15654	16588	17550	18538	19554	20596	21666
	13136	13970	14830	15715	16626	17562	18525	19512	20526
	12480	13272	14088	14929	15795	16684	17598	18537	19500
	11885	12640	13417	14218	15042	15890	16760	17654	18571
	11345	12065	12807	13572	14359	15167	15998	16851	17727
	10852	11541	12251	12982	13734	14508	15303	16119	16956
	10400	11060	11740	12441	13162	13903	14665	15447	16250
	9984	10617	11271	11943	12636	13347	14079	14829	15600
	9600	10209	10837	11484	12150	12834	13537	14259	15000
	9244	9831	10436	11059	11700	12359	13036	13731	14444
	8914	9480	10063	10664	11282	11917	12570	13240	13928
	8606	9153	9716	10296	10893	11506	12137	12784	13448
	8320	8848	9392	9953	10530	11123	11732	12358	13000
	8051	8562	9089	9632	10190	10764	11354	11959	12580
	7800	8295	8805	9331	9871	10427	10999	11585	12187

the above Table, when the number of supporting bolts in a r is *odd*, the number under the particular depth of girder equals ; but when the number of bolts is *even*, it equals $(W^2-P^2)D$. n the exact value or number is not found under the given depth, ext greater number in the same column is the number, opposite h will be found the working pressure in column 1.

W = Width of combustion box in inches.

D = Distance between centres of girders in inches.

P = Pitch of supporting bolts in inches.

Pressure per sq. in.	Depths of Girders in inches.								
	8¾	9	9¼	9½	9¾	10	10¼	10½	10¾
lbs. 5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	45937	48600	...	...	...	...	...	...	...
40	40195	42525	44920	47381	49907	...	...	...	...
45	35729	37800	39929	42116	44362	46666	49029	...	...
50	32156	34020	35936	37905	39926	42000	44126	46305	48536
55	29232	30927	32669	34459	36296	38181	40114	42095	44123
60	26796	28350	29946	31587	33271	35000	36771	38587	40446
65	24735	26169	27643	29157	30712	32307	33943	35619	37335
70	22968	24300	25668	27075	28518	30000	31518	33075	34668
75	21437	22680	23957	25270	26617	28000	29417	30870	32357
80	20097	21262	22460	23690	24953	26250	27578	28940	30335
85	18915	20011	21138	22297	23486	24705	25956	27238	28550
90	17864	18900	19964	21058	22181	23333	24514	25725	26964
95	16924	17905	18913	19950	21013	22105	23224	24371	25545
100	16078	17010	17968	18952	19963	21000	22063	23152	24268
105	15312	16200	17112	18050	19012	20000	21012	22050	23112
110	14616	15463	16334	17229	18148	19090	20057	21047	22061
115	13980	14791	15624	16480	17359	18260	19185	20132	21102
120	13398	14175	14973	15793	16635	17500	18385	19293	20223
125	12862	13608	14374	15162	15970	16800	17650	18522	19414
130	12367	13084	13821	14578	15356	16153	16971	17809	18667
135	11909	12600	13309	14038	14787	15555	16343	17150	17976
140	11484	12150	12834	13537	14259	15000	15759	16537	17334
145	11088	11731	12391	13070	13767	14482	15215	15967	16736
150	10718	11340	11978	12635	13308	14000	14708	15435	16178
155	10372	10974	11592	12227	12879	13548	14234	14937	15656
160	10048	10631	11230	11845	12476	13125	13789	14470	15167

In the above Table, when the number of supporting bolts in a girder is *odd*, the number under the particular depth of girder equals W^2D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. When the exact value or number is not found under the given depth, the next greater number in the same column is the number, opposite which will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = Pitch of supporting bolts in inches.

CYLINDRICAL BOILER SHELLS.
Iron Plates from $\frac{1}{4}$ Inch to $1\frac{1}{4}$ Inch Thick.

Numerals and *Nominal* Factors from 5 to 6·9.

By the use of the Tables Nos. 52 and 53, which immediately follow these remarks, the working pressure can be determined for any given thickness of plate and given diameter, when the calculated percentage strength of the longitudinal joint is known, and *nominal* factor fixed; the diameter can be found for a given thickness of plate, when the calculated percentage of the longitudinal joint is known and factor determined; the calculated percentage of the longitudinal joint can be obtained for a given thickness of plate, a given diameter and a given working pressure and *nominal* factor; and the thickness of the plate can be found when it is known what the diameter, working pressure, *nominal* factor, and the calculated percentage of longitudinal joint are to be. The *nominal* factor at which the boiler is, or will be, worked can also be ascertained, if between 5 and 6·9, when the thickness of the plate, the working pressure, diameter, and calculated percentage of the longitudinal joints, are known.

The Tables are computed on the assumption that the plates have a tensile strength of about 47,000 lbs. per square inch, which is usually taken as the strength in calculating the working pressure for Cylindrical Shells, Cylindrical Steam Receivers, or Domes of Boilers.

N = Numeral for the thickness and nominal factor of safety.
% = Calculated percentage of joint.
D = Diameter of boiler, inside, in inches.
B = Working pressure, in lbs., per square inch.
F = Nominal factor of safety.

$$\frac{N \times \%}{D} = B$$

$$\frac{N \times \%}{B} = D$$

$$\frac{D \times B}{N} = \%$$

$$\frac{D \times B}{\%} = N.$$

(1) If the working pressure has to be found when the plates are $1\frac{1}{4}$ inch, and the *nominal* factor 5, the calculated percentage of the joints 85·23, and the diameter 144 inches :—

Then, opposite the thickness of the plates, $1\frac{1}{4}$ inch, and under F 5, the *nominal* factor, the numeral is 235; and if it be multiplied by *85·23 (the calculated* percentage of the joints), and the

product divided by 144 (the diameter), the quotient eq
working pressure, or

$$\frac{235 \times 85 \cdot 23}{144} = 139 \cdot 09 = B,$$

which is the working pressure required to be found, or,
lbs. per square inch.

(2) If the thickness of the plates is required to be determine
the diameter is 144 inches, the pressure 140 lbs., the
factor 5, and the calculated percentage of joints 85·23 :—

Then, if 144 (the diameter) be multiplied by 140 (the p
and the product divided by 85·23 (the calculated perce
joints), the quotient equals the numeral applicable to t
which should be looked for under F 5, the *nominal* fac
opposite the numeral the thickness required may be found

$$\frac{144 \times 140}{85 \cdot 23} = 236 \cdot 5 = N.$$

But the nearest numeral under F 5 is 235, and as it
little from 236·5 $\left(\text{that found by the formula } \frac{D \times B}{\%}\right)$, th
ness opposite N 235 is the thickness which practicall
the requirements of the case, viz., 1¼ inch.

(3) If the diameter has to be settled for a working pressur
lbs. at a *nominal* factor 5, the thickness of plates 1¼ inch,
calculated percentage of joint 85·23 :—

Then, under F 5, the factor, and opposite 1¼, the thic
the plates, the numeral is 235; and if it be multiplied b
(the calculated percentage of joint), and the product divide
(the pressure), the quotient equals what the diameter shoul

$$\frac{235 \times 85 \cdot 23}{140} = 143 \cdot 06 = D,$$

or, the diameter to meet the requirements of the case
say, 144 inches.

(4) If the calculated percentage of joints has to be dete
when the plates are 1¼ inch thick, the *nominal* factor 5, the
pressure 140 lbs., and the diameter 144 inches :—

Then, if 140, the pressure, be multiplied by 144, the d
and the product divided by the numeral 235 found oppo
inch, the thickness, and under F 5, the *nominal* fac
quotient equals the calculated percentage of joint, or

$$\frac{140 \times 144}{235} = 85 \cdot 78 = \%,$$

but a suitable calculated percentage of joint for such a thickness of plate, when the riveting is as illustrated in Tables Nos. 63 and 64, is 85·23, which may be adopted without materially affecting the result.

The calculated percentages of joints made of iron plates and iron rivets, of various descriptions of riveting and of different thickness of plates, are given in Tables Nos. 54 to 64.

The *nominal* factor can be found by the tables when N, the numeral, is obtained $\left(\text{by the formula } \frac{D \times B}{\%}\right)$ for the given thickness, as above the numerals in any one column, the factor under F is the *nominal* factor in the particular case. If the exact numeral is not found opposite any given thickness, within the range of the Tables, but a numeral is between any two numerals, opposite the given thickness, then the *nominal* factor is between the factors at the top of the two columns in which the numerals are found—one slightly under and the other rather higher. Therefore the factor can always be determined within about one per cent., although the exact numeral may not be found in the Tables.

Thus, if the thickness be $1\frac{1}{4}$ inch and

$$\frac{D \times B}{\%} = 235,$$

235 is found opposite $1\frac{1}{4}$, and at the top of column in which 235 is found, the *nominal* factor is 5; but if by the formula the numeral arrived at had been, say, 232·2 (which is a number between the two numerals given in the Table opposite $1\frac{1}{4}$), then the *nominal* factor would be rather less than 5·1, but slightly over 5.

Iron Plates from ¼ inch to 1¼ inch Thick.

Numerals and *Nominal* Factors from 5 to 5·9.

Thickness of Plate.	F 5·0	F 5·1	F 5·2	F 5·3	F 5·4	F 5·5	F 5·6	F 5·7	F 5·8
ins.	N	N	N	N	N	N	N	N	N
¼	47·0	46·07	45·19	44·33	43·51	42·72	41·96	41·22	40·
9/32	52·87	51·83	50·84	49·88	48·95	48·06	47·20	46·38	45·
5/16	58·75	57·59	56·49	55·42	54·39	53·40	52·45	51·53	50·
11/32	64·62	63·35	62·13	60·96	59·83	58·75	57·70	56·68	55·
3/8	70·50	69·11	67·78	66·50	65·27	64·09	62·94	61·84	60·
13/32	76·37	74·87	73·43	72·05	70·71	69·43	68·19	66·99	65·
7/16	82·25	80·63	79·08	77·59	76·15	74·77	73·43	72·14	70·
15/32	88·12	86·39	84·73	83·13	81·59	80·11	78·68	77·30	75·
½	94·0	92·15	90·38	88·67	87·03	85·45	83·92	82·45	81·
17/32	99·87	97·91	96·03	94·22	92·47	90·79	89·17	87·60	86·
9/16	105·75	103·67	101·68	99·76	97·91	96·13	94·41	92·76	91·
19/32	111·62	109·43	107·33	105·30	103·35	101·47	99·66	97·91	96·
5/8	117·50	115·19	112·98	110·84	108·79	106·81	104·91	103·07	101·
21/32	123·37	120·95	118·62	116·39	114·23	112·15	110·15	108·22	106·
11/16	129·25	126·71	124·27	121·93	119·67	117·50	115·40	113·37	111·
23/32	135·12	132·47	129·92	127·47	125·11	122·84	120·64	118·53	116·
¾	141·0	138·23	135·57	133·01	130·55	128·18	125·89	123·68	121·
25/32	146·87	143·99	141·22	138·56	135·99	133·52	131·13	128·83	126·
13/16	152·75	149·75	146·87	144·10	141·43	138·86	136·38	133·99	131·
27/32	158·62	155·51	152·52	149·64	146·87	144·20	141·62	139·14	136·
7/8	164·50	161·27	158·17	155·18	152·31	149·54	146·87	144·29	141·
29/32	170·37	167·03	163·82	160·73	157·75	154·88	152·12	149·45	146·
15/16	176·25	172·79	169·47	166·27	163·19	160·22	157·36	154·60	151·
31/32	182·12	178·55	175·12	171·81	168·63	165·56	162·61	159·75	157·
1	188·0	184·31	180·76	177·35	174·07	170·90	167·85	164·91	162·
1 1/32	193·87	190·07	186·41	182·90	179·51	176·25	173·10	170·06	167·
1 1/16	199·75	195·83	192·06	188·44	184·95	181·59	178·34	175·21	172·
1 3/32	205·62	201·59	197·71	193·98	190·39	186·93	183·59	180·37	177·
1 1/8	211·50	207·35	203·36	199·52	195·83	192·27	188·83	185·52	182·
1 5/32	217·37	213·11	209·01	205·07	201·27	197·61	194·08	190·67	187·
1 3/16	223·25	218·87	214·66	210·61	206·71	202·95	199·33	195·83	192·
1 7/32	229·12	224·63	220·31	216·15	212·15	208·29	204·57	200·98	197·
1¼	235·0	230·39	225·96	221·69	217·59	213·63	209·82	206·14	202·

$$\frac{N \times \%}{D} = B$$

N=Numeral. %=Calculated percentage strength of joi
D=Inside diameter in inches.
B=Working pressure per square inch in pounds.

CYLINDRICAL BOILER SHELLS. TABLE No. 53.

Iron Plates from ¼ inch to 1¼ inch Thick.

Numerals and *Nominal* Factors from 6 to 6·9.

Thickness of Plate.	F 6·0	F 6·1	F 6·2	F 6·3	F 6·4	F 6·5	F 6·6	F 6·7	F 6·8	F 6·9
ins.	N	N	N	N	N	N	N	N	N	N
1/4	39·16	38·52	37·90	37·30	36·71	36·15	35·60	35·07	34·55	34·05
9/32	44·06	43·34	42·64	41·96	41·30	40·67	40·05	39·45	38·87	38·31
5/16	48·95	48·15	47·37	46·62	45·89	45·19	44·50	43·84	43·19	42·57
11/32	53·85	52·97	52·11	51·28	50·48	49·71	48·95	48·22	47·51	46·82
3/8	58·75	57·78	56·85	55·95	55·07	54·23	53·40	52·61	51·83	51·08
13/32	63·64	62·60	61·59	60·61	59·66	58·75	57·85	56·99	56·15	55·34
7/16	68·54	67·41	66·33	65·27	64·25	63·26	62·31	61·38	60·47	59·60
15/32	73·43	72·23	71·06	69·94	68·84	67·78	66·76	65·76	64·79	63·85
1/2	78·33	77·04	75·80	74·60	73·43	72·30	71·21	70·14	69·11	68·11
17/32	83·22	81·86	80·54	79·26	78·02	76·82	75·66	74·53	73·43	72·37
9/16	88·12	86·68	85·28	83·92	82·61	81·34	80·11	78·91	77·75	76·63
19/32	93·02	91·49	90·02	88·59	87·20	85·86	84·56	83·30	82·07	80·88
5/8	97·91	96·31	94·75	93·25	91·79	90·38	89·01	87·68	86·39	85·14
21/32	102·81	101·12	99·49	97·91	96·38	94·90	93·46	92·07	90·71	89·40
11/16	107·70	105·94	104·23	102·57	100·97	99·42	97·91	96·45	95·03	93·65
23/32	112·60	110·75	108·97	107·24	105·56	103·94	102·36	100·83	99·35	97·91
3/4	117·50	115·57	113·70	111·90	110·15	108·46	106·81	105·22	103·67	102·17
25/32	122·39	120·38	118·44	116·56	114·74	112·98	111·26	109·60	107·99	106·43
13/16	127·29	125·20	123·18	121·23	119·33	117·50	115·71	113·99	112·31	110·68
27/32	132·18	130·02	127·92	125·89	123·92	122·01	120·17	118·37	116·63	114·94
7/8	137·08	134·83	132·66	130·55	128·51	126·53	124·62	122·76	120·95	119·20
29/32	141·97	139·65	137·39	135·21	133·10	131·05	129·07	127·14	125·27	123·46
15/16	146·87	144·46	142·13	139·88	137·69	135·57	133·52	131·52	129·59	127·71
31/32	151·77	149·28	146·87	144·54	142·28	140·09	137·97	135·91	133·91	131·97
1	156·66	154·09	151·61	149·20	146·87	144·61	142·42	140·29	138·23	136·23
1 1/32	161·56	158·91	156·35	153·86	151·46	149·13	146·87	144·68	142·55	140·48
1 1/16	166·45	163·72	161·08	158·53	156·05	153·65	151·32	149·06	146·87	144·74
1 3/32	171·35	168·54	165·82	163·19	160·64	158·17	155·77	153·45	151·19	149·00
1 1/8	176·25	173·36	170·56	167·85	165·23	162·69	160·22	157·83	155·51	153·26
1 5/32	181·14	178·17	175·30	172·51	169·82	167·21	164·67	162·22	159·83	157·51
1 3/16	186·04	182·99	180·04	177·18	174·41	171·73	169·12	166·60	164·15	161·77
1 7/32	190·93	187·80	184·77	181·84	179·0	176·25	173·57	170·98	168·47	166·03
1 1/4	195·83	192·62	189·51	186·50	183·59	180·76	178·03	175·37	172·79	170·28

$$\frac{N \times \%}{D} = B$$

N = Numeral. % = Calculated percentage strength of joint.
D = Inside diameter in inches.
B = Working pressure *per* square inch in pounds.

IRON PLATES AND IRON RIVETS.

Riveted Joints.

In the Tables Nos. 54 to 64, which immediately follo remarks, the particulars as to the proportions of riveted joint of iron plates with iron rivets, are given. By the use of thes the working pressure may be found for any given diameter and *nominal* factor of safety, or the diameter determined for working pressure and *nominal* factor, or the *nominal* factor asc for a given pressure and diameter.

The tables have been computed on the assumption that th strength of iron boiler plates is about 47000 lbs. per squa which is the usual recognised number used in making such tions; the shearing strength of the rivets, per square inch, is as equal to the tensile strength of the plates, which is genera when iron plates and iron rivets are used in boilers.

The calculated percentage of joint, as given opposite the t of plate, in each case, is applicable when the diameter and rivets are in accordance with the tables, and centre of rivets of plates and distance between rows of rivets, not less tha opposite the particular thickness of plate.

The pitches of the rivets, in Column *p*, are given in the t decimal parts of an inch, but the nearest $1/_{32}$ part of an inch adopted without materially affecting the result.

The distance between the rows of rivets, in Column V, an of rivets to edge of plates, in Column E, should not be less th given in the table for the description of joint shown by the ske the top of the table, and opposite the particular thickness of pl

N = Numeral opposite the thickness of the plate, and ap to the description of riveting, as shown in the ske the top of the table from which the numeral is select the riveting proportioned as given opposite the thick question. *The table used must always be that for th cular description of joint which is being dealt with.*

D = Diameter of boiler, inside, in inches.

B = Working pressure, in lbs., per square inch.

F = Nominal factor of safety, the value of which should, in measure, be determined according to the method struction (see pages 17, 18, 19, and 20).

$$D \times B \times F = N.$$

$$\frac{N}{B \times F} = D.$$

$$\frac{N}{D \times F} = B.$$

$$\frac{N}{D \times B} = F.$$

(1) If the working pressure be required to be found, when the longitudinal seams are of the ordinary double riveted description, either zig-zag or chain riveted, and have double butt straps, the plates being of iron ⅝ inch thick, and the rivets also of iron, the inside diameter of the boiler 90 inches, and the *nominal* factor of safety 5:—

In the table of iron plates and iron rivets, double riveted double butt straps, ordinary zig-zag or chain riveting, as shown in the sketches at the top of Table No. 60, then, on the left, opposite ⅝, the thickness of the plate, the numeral N is found to be 45901, and if that be divided by the product of 90, the diameter, and 5, the *nominal* factor, the *quotient* is the working pressure. The calculated percentage strength of the joint is 78·13, as found on the right, opposite the thickness ⅝ inch, which is the value, if the riveting be of the description stated, and the pitch and rivets, &c., are as given opposite the thickness of plate, or—

$$\frac{45901}{90 \times 5} = 102 = B,$$

the working pressure, in lbs., per square inch.

(2) If the diameter of a boiler is required to be determined when the riveting is the *same* as above, the plates being also ⅝ inch thick, the *nominal* factor 5, and the pressure 100 lbs.:—

Opposite ⅝ inch, thickness of plate, the numeral N is 45901, which divided by 100 × 5 (the pressure and factor respectively) equals the working pressure, or

$$\frac{45901}{100 \times 5} = 91 \cdot 8 = D,$$

the inside diameter, in inches, which the boiler may have, or, say, 92 inches.

(3) If it is wished to determine what factor of safety a boiler is working at when the riveting is the same as above, the plates ⅝ inch thick (opposite the calculated percentage 78·13 is found on the right) the numeral N (opposite ⅝, on the left), 45901, the diameter being 90 inches, and the pressure 100 lbs.:—

The factor of safety is found by dividing the numeral 45901 by the product of 90, the diameter, and 100, the pressure, or

$$\frac{45901}{100 \times 90} = 5 \cdot 1 = F,$$

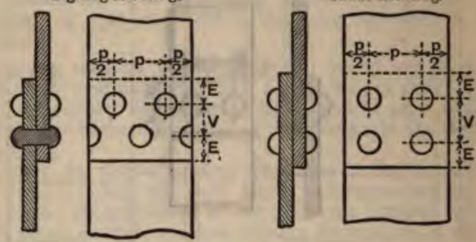
the *nominal* factor at which such a boiler works under the circumstances stated.

(4) If it is wished to determine what thickness the shell of an iron boiler should be, if the working pressure is required to be 100 lbs., the diameter 90 inches, and the *nominal* factor 5·1, the joints being double riveted *with double butt straps* fitted:—

IRON PLATES AND IRON RIVETS.

Double Riveted Lap Joints.

Zig Zag Riveting. **Chain Riveting.**



D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.
N	T	d	p	E	V	V
21296	5/16	5/8	2·272	·937	1·145	1·750
23426	11/32	21/32	2·386	·984	1·202	1·812
25556	3/8	11/16	2·500	1·031	1·260	1·875
27685	13/32	23/32	2·613	1·078	1·317	1·937
29815	7/16	3/4	2·727	1·125	1·374	2·000
31879	15/32	25/32	2·826	1·171	1·426	2·062
33764	1/2	13/16	2·886	1·218	1·465	2·125
35640	17/32	27/32	2·948	1·265	1·504	2·187
37514	9/16	7/8	3·013	1·312	1·544	2·250
39381	19/32	29/32	3·079	1·359	1·585	2·312
41242	5/8	15/16	3·146	1·406	1·626	2·375
43094	21/32	31/32	3·215	1·453	1·667	2·437
44940	11/16	1	3·284	1·500	1·709	2·500
46793	23/32	1 1/32	3·355	1·546	1·751	2·562
48630	3/4	1 1/16	3·426	1·593	1·794	2·625
50473	25/32	1 3/32	3·498	1·640	1·836	2·687
52309	13/16	1 1/8	3·571	1·687	1·879	2·750
54146	27/32	1 5/32	3·645	1·734	1·923	2·812
55979	7/8	1 3/16	3·718	1·781	1·966	2·875
57808	29/32	1 7/32	3·793	1·828	2·009	2·937
59634	15/16	1 1/4	3·867	1·875	2·053	3·000
61458	31/32	1 9/32	3·942	1·921	2·096	3·062
63290	1	1 5/16	4·018	1·968	2·140	3·125

N = Numeral. D = Diameter of boiler, inside, in inches.
B = *Working* pressure, in pounds, per square inch. F = *Nominal* factor of sa

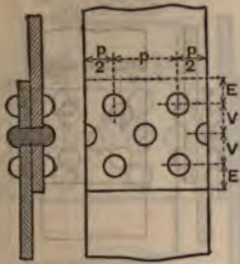
$D\times B\times F = N \qquad \frac{N}{B\times F} = D \qquad \frac{N}{D\times F} = B \qquad \frac{N}{D\times B} = F$

IRON PLATES AND IRON RIVETS.

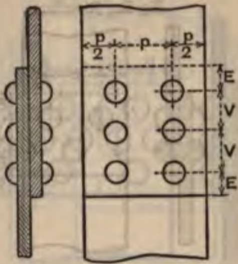
Table No. 56.

Treble Riveted Lap Joints.

Zig Zag Riveting.



Chain Riveting.

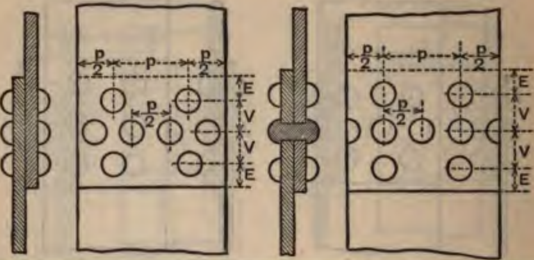


B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Percentage of Joint.
N	T	d	p	E	V	V	
7671	3/8	5/8	2·906	·937	1·365	1·750	78·50
9977	13/32	21/32	3·052	·984	1·433	1·812	78·50
2283	7/16	11/16	3·197	1·031	1·501	1·875	78·50
4505	15/32	23/32	3·315	1·078	1·560	1·937	78·31
6631	1/2	3/4	3·400	1·125	1·607	2·000	77·94
8751	17/32	25/32	3·488	1·171	1·656	2·062	77·60
0861	9/16	13/16	3·577	1·218	1·705	2·125	77·28
2970	19/32	27/32	3·668	1·265	1·754	2·187	76·99
5078	5/8	7/8	3·761	1·312	1·805	2·250	76·73
7178	21/32	29/32	3·854	1·359	1·855	2·312	76·48
9276	11/16	15/16	3·949	1·406	1·905	2·375	76·25
1374	23/32	31/32	4·045	1·453	1·957	2·437	76·04
3474	3/4	1	4·141	1·500	2·008	2·500	75·85
5562	25/32	1 1/32	4·238	1·546	2·060	2·562	75·66
655	13/16	1 1/16	4·336	1·593	2·111	2·625	75·49
746	27/32	1 3/32	4·434	1·640	2·163	2·687	75·33
827	7/8	1 1/8	4·533	1·687	2·215	2·750	75·17
916	29/32	1 5/32	4·632	1·734	2·268	2·812	75·03
996	15/16	1 3/16	4·731	1·781	2·320	2·875	74·89
087	31/32	1 7/32	4·831	1·828	2·372	2·937	74·77
171	1	1 1/4	4·931	1·875	2·425	3·000	74·65
247	1 1/32	1 9/32	5·031	1·921	2·478	3·062	74·53
326	1 1/16	1 5/16	5·132	1·968	2·530	3·125	74·42

= Numeral. D = Diameter of boiler, inside, in inches.
= Working pressure, in *pounds*, per square inch. F = *Nominal* factor of safety.

$D \times B \times F = N$ $\qquad \frac{N}{B \times F} = D$ $\qquad \frac{N}{D \times F} = B$ $\qquad \frac{N}{D \times B} = F$

Treble Riveted Lap Joints; each alternate Rivet omitted in the outer rows.



D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting	Distance between Rows of Rivets. Chain Riveting.	Perce age Join
N	T	d	p	E	V	V	
33627	7/16	5/8	3·430	·937	1·414	1·750	81·
35897	15/32	21/32	3·542	·984	1·473	1·812	81·
38164	1/2	11/16	3·657	1·031	1·532	1·875	81·
40424	17/32	23/32	3·773	1·078	1·592	1·937	80·
42680	9/16	3/4	3·891	1·125	1·652	2·000	80·
44934	19/32	25/32	4·010	1·171	1·712	2·062	80·
47188	5/8	13/16	4·130	1·218	1·772	2·125	80·
49442	21/32	27/32	4·251	1·265	1·833	2·187	80·
51700	11/16	7/8	4·375	1·312	1·894	2·250	80·
54050	23/32	15/16	4·687	1·406	2·029	2·375	80·
56400	3/4	31/32	4·843	1·453	2·097	2·437	80·
58750	25/32	1	5·000	1·500	2·165	2·500	80·
61100	13/16	1 1/32	5·156	1·546	2·232	2·562	80·
63450	27/32	1 3/32	5·468	1·640	2·368	2·687	80·
65800	7/8	1 1/8	5·625	1·687	2·435	2·750	80·
68150	29/32	1 5/32	5·781	1·734	2·503	2·812	80·
70500	15/16	1 7/32	6·093	1·828	2·638	2·937	80·
72850	31/32	1 1/4	6·250	1·875	2·706	3·000	80·
75200	1	1 9/32	6·406	1·921	2·773	3·062	80·
77550	1 1/32	1 5/16	6·562	1·968	2·841	3·125	80·
79900	1 1/16	1 3/8	6·875	2·062	2·976	3·250	80·
82250	1 3/32	1 13/32	7·031	2·109	3·044	3·312	80·
84600	1 1/8	1 7/16	7·187	2·156	3·112	3·375	80·

N=Numeral. D=Diameter of boiler, inside, in inches.
B=Working pressure, in pounds, per square inch. F=*Nominal* factor of safet

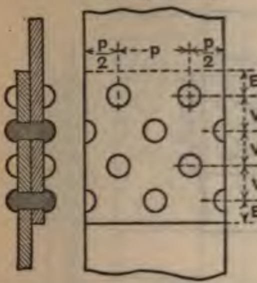
$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

IRON PLATES AND IRON RIVETS.

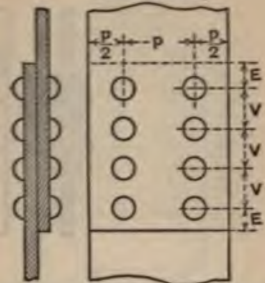
TABLE No. 58.

Quadruple Riveted Lap Joints.

Zig Zag Riveting.



Chain Riveting.

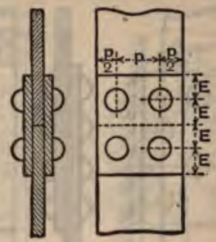


D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Percentage of Joint.
N	T	d	p	E	V	V	
33627	7/16	5/8	3·430	0·937	1·544	1·750	81·77
35897	15/32	21/32	3·542	0·984	1·601	1·812	81·47
38164	1/2	11/16	3·657	1·031	1·659	1·875	81·20
40424	17/32	23/32	3·773	1·078	1·717	1·937	80·95
42680	9/16	3/4	3·891	1·125	1·776	2·000	80·72
44934	19/32	25/32	4·010	1·171	1·835	2·062	80·51
47188	5/8	13/16	4·130	1·218	1·895	2·125	80·32
49442	21/32	27/32	4·251	1·265	1·955	2·187	80·15
51693	11/16	7/8	4·373	1·312	2·015	2·250	79·99
53941	23/32	29/32	4·496	1·359	2·076	2·312	79·84
56188	3/4	15/16	4·619	1·406	2·136	2·375	79·70
58434	25/32	31/32	4·742	1·453	2·197	2·437	79·57
60672	13/16	1	4·866	1·500	2·258	2·500	79·44
62918	27/32	1 1/32	4·990	1·546	2·319	2·562	79·33
65158	7/8	1 1/16	5·115	1·593	2·380	2·625	79·22
67400	29/32	1 3/32	5·240	1·640	2·441	2·687	79·12
69645	15/16	1 1/8	5·366	1·687	2·503	2·750	79·03
71884	31/32	1 5/32	5·491	1·734	2·564	2·812	78·94
74119	1	1 3/16	5·617	1·781	2·626	2·875	78·85
76357	1 1/32	1 7/32	5·743	1·828	2·688	2·937	78·77
78601	1 1/16	1 1/4	5·870	1·875	2·749	3·000	78·70
80841	1 3/32	1 9/32	5·996	1·921	2·811	3·062	78·63
83077	1 1/8	1 5/16	6·123	1·968	2·873	3·125	78·56

N = Numeral. D = Diameter of boiler, inside, in inches.
B = Working pressure, in pounds, per square inch. F = Nominal factor of safety.

$D \times B \times F = N$ $\qquad \frac{N}{B \times F} = D$ $\qquad \frac{N}{D \times F} = B$ $\qquad \frac{N}{D \times B} = F$

Single Riveted Double Butt Joints.



D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Thickness of Butt Straps.
N	T	d	p	E	T_1
23970	3/8	5/8	1·953	0·937	·234
25967	13/32	21/32	2·050	0·984	·253
27965	7/16	11/16	2·148	1·031	·273
29878	15/32	23/32	2·233	1·078	·292
31645	1/2	3/4	2·296	1·125	·312
33403	17/32	25/32	2·360	1·171	·332
35156	9/16	13/16	2·425	1·218	·351
36903	19/32	27/32	2·491	1·265	·371
38651	5/8	7/8	2·558	1·312	·390
40392	21/32	29/32	2·626	1·359	·410
42135	11/16	15/16	2·694	1·406	·429
43868	23/32	31/32	2·763	1·453	·449
45599	3/4	1	2·832	1·500	·468
47337	25/32	1 1/32	2·902	1·546	·488
49063	13/16	1 1/16	2·972	1·593	·507
50791	27/32	1 3/32	3·042	1·640	·527
52524	7/8	1 1/8	3·113	1·687	·546
54238	29/32	1 5/32	3·183	1·734	·566
55959	15/16	1 3/16	3·254	1·781	·585
57688	31/32	1 7/32	3·326	1·828	·605
59408	1	1 1/4	3·397	1·875	·625
61128	1 1/32	1 9/32	3·469	1·921	·644
62841	1 1/16	1 5/16	3·540	1·968	·664

N = Numeral. D = Diameter of boiler, inside, in inches.
B = Working pressure, in pounds, per square inch. F = *Nominal* factor

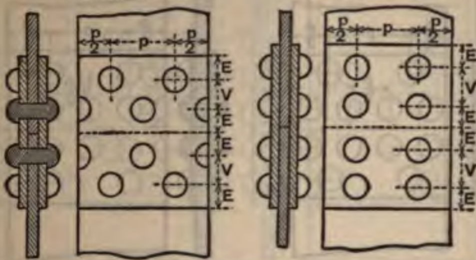
$D\times B\times F = N$ $\qquad \frac{N}{B\times F} = D$ $\qquad \frac{N}{D\times F} = B$ $\qquad \frac{N}{D\times B} =$

IRON PLATES AND IRON RIVETS.

TABLE No. 60.

Double Riveted Double Butt Joints.

Zig Zag Riveting. Chain Riveting.



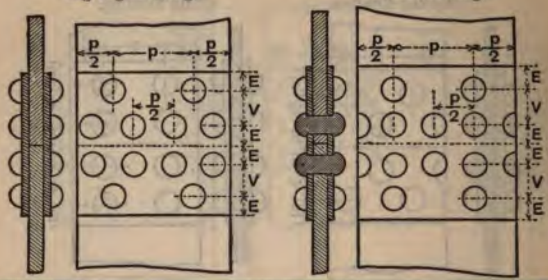
×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Chain Riveting.	Thickness of Butt Straps.	Percentage of Joint.
N	T	d	p	E	V	V	T_1	
776	7/16	5/8	3·079	0·937	1·424	1·750	·273	79·70
972	15/32	21/32	3·181	0·984	1·477	1·812	·292	79·37
162	1/2	11/16	3·286	1·031	1·532	1·875	·312	79·07
350	17/32	23/32	3·391	1·078	1·586	1·937	·332	78·80
538	9/16	3/4	3·498	1·125	1·641	2·000	·351	78·56
717	19/32	25/32	3·606	1·171	1·697	2·062	·371	78·33
901	5/8	13/16	3·716	1·218	1·753	2·125	·390	78·13
079	21/32	27/32	3·825	1·265	1·808	2·187	·410	77·94
252	11/16	7/8	3·936	1·312	1·865	2·250	·429	77·76
428	23/32	29/32	4·047	1·359	1·921	2·312	·449	77·60
602	3/4	15/16	4·158	1·406	1·978	2·375	·468	77·45
774	25/32	31/32	4·270	1·453	2·035	2·437	·488	77·31
946	13/16	1	4·383	1·500	2·092	2·500	·507	77·18
110	27/32	1 1/32	4·495	1·546	2·149	2·562	·527	77·05
283	7/8	1 1/16	4·609	1·593	2·206	2·625	·546	76·94
449	29/32	1 3/32	4·722	1·640	2·263	2·687	·566	76·83
618	15/16	1 1/8	4·836	1·687	2·320	2·750	·585	76·73
781	31/32	1 5/32	4·949	1·734	2·377	2·812	·605	76·63
947	1	1 3/16	5·063	1·781	2·435	2·875	·625	76·54
118	1 1/32	1 7/32	5·178	1·828	2·493	2·937	·644	76·46
274	1 1/16	1 1/4	5·292	1·875	2·550	3·000	·664	76·37
435	1 3/32	1 9/32	5·406	1·921	2·608	3·062	·683	76·29
602	1 1/8	1 5/16	5·521	1·968	2·665	3·125	·703	76·22

=Numeral. D=Diameter of boiler, inside, in inches.
=Working pressure, in pounds, per square inch. F=Nominal factor of safety.

$D \times B \times F = N$ $\quad \frac{N}{B \times F} = D \quad \frac{N}{D \times F} = B \quad \frac{N}{D \times B} = F$

Double Riveted Double Butt Joints, each alternate Rivet omitted in the outer rows.

Zig Zag Riveting. Chain Riveting.

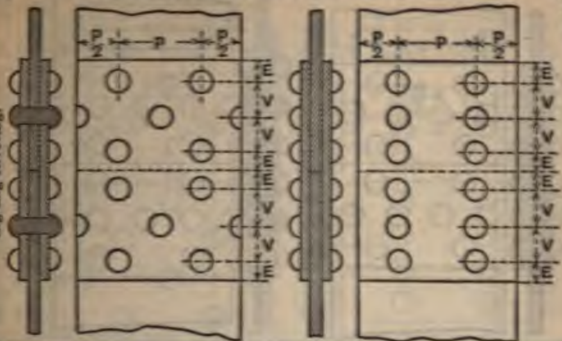


D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Thickness of Butt Straps.	Perce age Join
N	T	d	p	E	V	V	T_1	
39357	1/2	5/8	3·846	0·937	1·496	1·750	·387	83·[illegible]
41737	17/32	21/32	3·998	0·984	1·563	1·812	·413	83·[illegible]
44118	9/16	11/16	4·152	1·031	1·630	1·875	·438	83·[illegible]
46491	19/32	23/32	4·306	1·078	1·698	1·937	·464	83·[illegible]
48868	5/8	3/4	4·461	1·125	1·765	2·000	·489	83·[illegible]
51243	21/32	25/32	4·616	1·171	1·833	2·062	·515	83·[illegible]
53619	11/16	13/16	4·771	1·218	1·900	2·125	·540	82·[illegible]
55989	23/32	27/32	4·927	1·265	1·968	2·187	·566	82·[illegible]
58359	3/4	7/8	5·084	1·312	2·036	2·258	·591	82·[illegible]
60732	25/32	29/32	5·240	1·359	2·103	2·330	·617	82·[illegible]
63101	13/16	15/16	5·397	1·406	2·171	2·402	·642	82·[illegible]
65472	27/32	31/32	5·555	1·453	2·239	2·475	·668	82·[illegible]
67848	7/8	1	5·712	1·500	2·307	2·547	·694	82·[illegible]
70211	29/32	1 1/32	5·869	1·546	2·375	2·619	·719	82·[illegible]
72588	15/16	1 1/16	6·027	1·593	2·443	2·692	·745	82·[illegible]
74953	31/32	1 3/32	6·185	1·640	2·511	2·765	·771	82·[illegible]
77324	1	1 1/8	6·343	1·687	2·579	2·837	·796	82·[illegible]
79692	1 1/32	1 5/32	6·501	1·734	2·647	2·910	·822	82·[illegible]
82057	1 1/16	1 3/16	6·659	1·781	2·715	2·983	·848	82·1
84429	1 3/32	1 7/32	6·818	1·828	2·783	3·056	·873	82·1
86799	1 1/8	1 1/4	6·976	1·875	2·851	3·128	·899	82·[illegible]
89167	1 5/32	1 9/32	7·135	1·921	2·920	3·201	·925	82·[illegible]
91532	1 3/16	1 5/16	7·294	1·968	2·988	3·274	·950	82·[illegible]

N = Numeral. D = Diameter of boiler, inside, in inches.
B = Working pressure, in pounds, per square inch. F = *Nominal* factor of safety.

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

Zig Zag Riveting.



Chain Riveting.

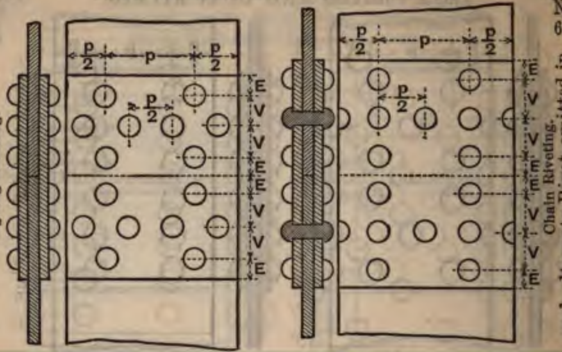
B×F,	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Thickness of Butt Strap.	Percentage of Joint.
N	T	d	p	E	V	V	T_1	
357	1/2	5/8	3·846	0·937	1·686	1·750	·312	83·74
737	17/32	21/32	3·998	0·984	1·756	1·812	·332	83·58
118	9/16	11/16	4·152	1·031	1·828	1·875	·351	83·44
491	19/32	23/32	4·306	1·078	1·899	1·937	·371	83·30
868	5/8	3/4	4·461	1·125	1·971	2·000	·390	83·18
243	21/32	25/32	4·616	1·171	2·042	2·062	·410	83·07
619	11/16	13/16	4·771	1·218	2·114	2·125	·429	82·97
989	23/32	27/32	4·927	1·265	2·186	2·187	·449	82·87
359	3/4	7/8	5·084	1·312	2·258	2·250	·468	82·78
732	25/32	29/32	5·240	1·359	2·330	2·312	·488	82·70
101	13/16	15/16	5·397	1·406	2·402	2·375	·507	82·62
472	27/32	31/32	5·555	1·453	2·475	2·437	·527	82·55
848	7/8	1	5·712	1·500	2·547	2·500	·546	82·49
211	29/32	1 1/32	5·869	1·546	2·619	2·562	·566	82·42
588	15/16	1 1/16	6·027	1·593	2·692	2·625	·585	82·37
953	31/32	1 3/32	6·185	1·640	2·765	2·687	·605	82·31
324	1	1 1/8	6·343	1·687	2·837	2·750	·625	82·26
692	1 1/32	1 5/32	6·501	1·734	2·910	2·812	·644	82·21
057	1 1/16	1 3/16	6·659	1·781	2·983	2·875	·664	82·16
429	1 3/32	1 7/32	6·818	1·828	3·056	2·937	·683	82·12
799	1 1/8	1 1/4	6·976	1·875	3·128	3·000	·703	82·08
167	1 5/32	1 9/32	7·135	1·921	3·201	3·062	·722	82·04
532	1 3/16	1 5/16	7·294	1·968	3·274	3·125	·742	82·00

N=Numeral. D=Diameter of boiler, inside, in inches.
B=Working pressure, in pounds, per square inch. F=*Nominal factor of safety.*

$D \times B \times F = N$ $\frac{N}{B \times F} = D$ $\frac{N}{D \times F} = B$ $\frac{N}{D \times B} = F$

Treble Riveted Double Butt Joints,
Zig Zag Riveting.

Chain Riveting.
each alternate Rivet omitted in



D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Chain Riveting.	Thickness of Butt Straps.	Per ag Jo
N	T	d	p	E	V	V	T_1	
45430	9/16	5/8	4·442	0·937	1·612	1·888	·351	85
47920	19/32	21/32	4·643	0·984	1·688	1·975	·371	85
50407	5/8	11/16	4·844	1·031	1·765	2·062	·390	85
52897	21/32	23/32	5·046	1·078	1·841	2·150	·410	85
55383	11/16	3/4	5·248	1·125	1·918	2·238	·429	85
57874	23/32	25/32	5·449	1·171	1·995	2·325	·449	85
60362	3/4	13/16	5·651	1·218	2·072	2·412	·468	85
62847	25/32	27/32	5·853	1·265	2·148	2·500	·488	85
65331	13/16	7/8	6·055	1·312	2·225	2·588	·507	85
67820	27/32	29/32	6·257	1·359	2·302	2·675	·527	85
70307	7/8	15/16	6·459	1·406	2·378	2·763	·546	85
72792	29/32	31/32	6·661	1·453	2·455	2·850	·566	85
75285	15/16	1	6·864	1·500	2·532	2·938	·585	85
77767	31/32	1 1/32	7·066	1·546	2·609	3·026	·605	85
80257	1	1 1/16	7·268	1·593	2·686	3·114	·625	85
82736	1 1/32	1 3/32	7·470	1·640	2·762	3·201	·644	85
85223	1 1/16	1 1/8	7·673	1·687	2·839	3·289	·664	85
87709	1 3/32	1 5/32	7·876	1·734	2·916	3·377	·683	85
90194	1 1/8	1 3/16	8·078	1·781	2·993	3·465	·703	85
92688	1 5/32	1 7/32	8·281	1·828	3·070	3·553	·722	85
95171	1 3/16	1 1/4	8·484	1·875	3·147	3·641	·742	85
97653	1 7/32	1 9/32	8·686	1·921	3·223	3·728	·761	85
100145	1 1/4	1 5/16	8·888	1·968	3·300	3·816	·781	85

N = Numeral. D = Diameter of boiler, inside, in inches.
B = Working pressure, in pounds, per square inch. F = *Nominal* factor of safet

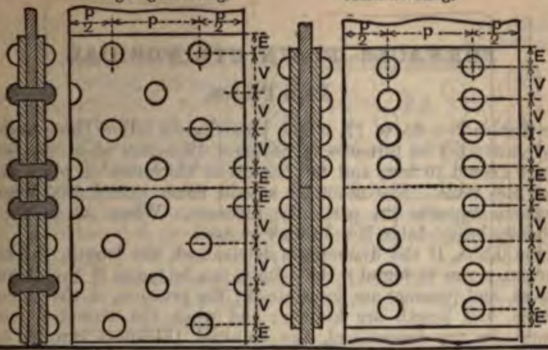
$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

IRON PLATES AND IRON RIVETS.

TABLE No. 64.

Quadruple Riveted — Double Butt Joints.

Zig Zag Riveting. Chain Riveting.



D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Thickness of Butt Straps.	Percentage of Joint.
N	T	d	p	E	V	V	T_1	
45430	9/16	5/8	4·442	0·937	1·888	1·750	·351	85·92
47920	19/32	21/32	4·643	0·984	1·975	1·812	·371	85·86
50407	5/8	11/16	4·844	1·031	2·062	1·875	·390	85·80
52897	21/32	23/32	5·046	1·078	2·150	1·937	·410	85·75
55383	11/16	3/4	5·248	1·125	2·238	2·000	·429	85·70
57874	23/32	25/32	5·449	1·171	2·325	2·062	·449	85·66
60362	3/4	13/16	5·651	1·218	2·412	2·125	·468	85·62
62847	25/32	27/32	5·853	1·265	2·500	2·187	·488	85·58
65331	13/16	7/8	6·055	1·312	2·588	2·250	·507	85·54
67820	27/32	29/32	6·257	1·359	2·675	2·312	·527	85·51
70307	7/8	15/16	6·459	1·406	2·763	2·375	·546	85·48
72792	29/32	31/32	6·661	1·453	2·850	2·437	·566	85·45
75285	15/16	1	6·864	1·500	2·938	2·500	·585	85·43
77767	31/32	1 1/32	7·066	1·546	3·026	2·562	·605	85·40
80257	1	1 1/16	7·268	1·593	3·114	2·625	·625	85·38
82736	1 1/32	1 3/32	7·470	1·640	3·201	2·687	·644	85·35
85223	1 1/16	1 1/8	7·673	1·687	3·289	2·750	·664	85·33
87709	1 3/32	1 5/32	7·876	1·734	3·377	2·812	·683	85·31
90194	1 1/8	1 3/16	8·078	1·781	3·465	2·875	·703	85·29
92688	1 5/32	1 7/32	8·281	1·828	3·553	2·937	·722	85·28
95171	1 3/16	1 1/4	8·484	1·875	3·641	3·000	·742	85·26
97653	1 7/32	1 9/32	8·686	1·921	3·728	3·062	·761	85·24
100145	1 1/4	1 5/16	8·888	1·968	3·816	3·125	·781	85·23

N = Numeral. D = Diameter of boiler, inside, in inches.
B = Working pressure, in pounds, per square inch. F = *Nominal* factor of safety.

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

FURNACES—PLAIN CYLINDRICAL.

Iron Plates.

The Tables No. 65 to 77, which immediately follow these remark are only intended for furnaces of ordinary diameters when the lengt does not exceed 10 feet, and for the given thickness of plate at th head of the table. The diameter should never exceed that found i the column opposite the particular pressure. When A1 is the di tinguishing letter, table No. 78 may be used.

By the tables, if the diameter is determined, the length, thicknes and pressure can be found; the length can be found if the diamete thickness, and pressure are determined; the pressure, if the diamete thickness, and length are known; and when the diameter, lengt and pressure are determined, the required thickness can be asce tained.

The numerals in each table, under each distinguishing letter, a those applicable to the circumstances of the case to which the lett refers, and to the thickness of the plate at the head of the table.

The distinguishing letters refer to the method adopted in constru ing the furnaces, as the following will explain.

Distinguishing Letters.		Distinguishi Letters.
A1.	Longitudinal seams welded, ...	A1.
A.	Longitudinal seams, double riveted, single butt straps, and holes *drilled*, ...	A.
A.	Longitudinal seams, single riveted, double butt straps, and holes *drilled*.	A.
B.	Longitudinal seams, double riveted, single butt straps, and holes *punched*, ...	B.
B.	Longitudinal seams, single riveted, double butt straps, and holes *punched*, ...	B.
C.	Longitudinal seams, single riveted, single butt straps, and holes *drilled*, ...	C.
C.	Longitudinal seams, double riveted, lap joints bevelled, and holes *drilled*, ...	C.
D.	Longitudinal seams, single riveted, single butt straps, and holes *punched*, ...	D.
D.	Longitudinal seams, double riveted, lap joints *not* bevelled, and holes *drilled*, ...	D.
D.	Longitudinal seams, double riveted, lap joints bevelled, and holes *punched*, ...	D.
E.	Longitudinal seams, single riveted, lap joints bevelled, and holes *drilled*, ...	E.
E.	Longitudinal seams, double riveted, lap joints *not bevelled*, and holes *punched*, ...	E.

stinguishing Letters.		Distinguishing Letters.
F.	Longitudinal seams, single riveted, lap joints *not* bevelled, and holes *drilled*, ...	F.
F.	Longitudinal seams, single riveted, lap joints bevelled, and holes *punched*, ...	F.
G.	Longitudinal seams, single riveted, lap joints *not* bevelled, and holes *punched*, ...	G.

From the foregoing it will be seen that the distinguishing letter A s reference to three different methods of construction, the letter B two, the letter C to two, the letter D to three, the letter E to two, e letter F to two, and G to one method.

N = Numeral in the tables, applicable to the method of construction.
L = Length of furnace in feet (for the limits of L, see the first paragraph of these notes).
D = Diameter of furnace, in inches, outside.
B = Working pressure, in lbs., per square inch.

(1) The *maximum* diameter in inches of a *horizontal* furnace for any ssure, if the length of the furnace, the thickness of plate, and ssure be determined, may be found by dividing the numeral, in the umn applicable to the class of furnace or method of construction and posite to the given pressure, by the length of furnace in feet, *plus* 1; the outside diameter in inches should not exceed $\frac{N}{L+1} = D$.

If the thickness of plates be ½ inch, the length 5·25 feet, and the essure 100 lbs., and the *horizontal* furnace is of the description to ich the distinguishing letter A is applicable, and it is required to termine the maximum outside diameter:—

Then, in the table for ½-inch iron plates (No. 73) opposite 100 lbs., the pressure, in the column A, applicable to the case, 225, the numeral is found; and if this be divided by 6·25, the length in feet *plus* 1, the result is 36, which is the greatest outside diameter in inches which the furnace should be,

$$\text{or} \quad \frac{225}{5{\cdot}25+1} = 36 = D.$$

(2) The maximum length in feet of a *horizontal* furnace, for any essure, if the diameter of the furnace and thickness of plate be dermined, may be found by dividing the numeral applicable to the ass of furnace, or method of construction, and opposite the given essure, by the diameter in inches, and diminishing the result by 1; the length should not exceed $\frac{N}{D}-1 = L$.

If the thickness of the iron plates be ½ inch, the outside diameter inches, and the pressure 100 lbs., and the *horizontal* furnace is of e description to which the distinguishing letter A is applicable, and is *required to determine the greatest* length:—

Then, in the table for ½-inch iron plates (No. 73) opposite 100 lbs., the pressure, in the column A applicable to the case, 225, the numeral, is found, and if it be divided by 36, the outside diameter, the result is 6·25, and if this be lessened by 1 it equals 5·25, which is the greatest length in feet the furnace should be,

$$\text{or} \quad \frac{225}{36} = 6{\cdot}25,$$
$$\text{and} \quad 6{\cdot}25 - 1 = 5{\cdot}25 = \text{L}.$$

(3) The maximum pressure for any *horizontal* furnace, if the diameter of the furnace, the thickness of plate, and the length be known, may be found by multiplying the diameter in inches by the length in feet, *plus* 1; the result gives the numeral, which should be looked for under the distinguishing letter applicable to the class of furnace or method of construction, and opposite the numeral so arrived at, the greatest pressure is found on the left in the first column on the page,

$$\text{or} \quad \text{D} \times (\text{L}+1) = \text{N},$$

and the pressure found on the left of the page, opposite the numeral, in the column under the distinguishing letter applicable to the case, is the greatest pressure.

If the thickness of the iron plates be ½ inch, the outside diameter 36 inches, and the length 5·25 feet, and the furnace is of the description to which the distinguishing letter A is applicable, and the greatest working pressure is required to be determined:—

Then, if 36, the outside diameter, be multiplied by 6·25, which is the length, *plus* 1, the result is 225, the numeral, and in the table for ½ inch plate, in column A, applicable to the case, opposite 225 on the left of the page, 100 lbs. pressure is found, which is the greatest working pressure,

$$\text{or} \quad 36 \times (5{\cdot}25+1) \text{ or } 36 \times 6{\cdot}25 = 225 = \text{N},$$

and opposite the numeral 225, the pressure found is 100 lbs. = B.

(4) The minimum thickness of the plate of a *horizontal* furnace if the pressure, diameter, and length of furnace and class of furnace, or method of construction, be known, may be found by multiplying the diameter in inches by the length in feet, *plus* 1, which gives the numeral; which numeral should be looked for *opposite* the pressure in a column of the tables under the distinguishing letter applicable to the class of furnace, and if such a number is not found, the next higher number is the numeral to adopt, and at the head of the table the thickness of plate given is the least thickness,

$$\text{or} \quad \text{D} \times (\text{L}+1) = \text{N}.$$

If the outside diameter of a horizontal iron furnace be 36 inches, the length 5·25 feet, and the pressure 100 lbs., and the class of furnace

s such as the distinguishing letter A refers to, and the *minimum* hickness of plate is required:—

Then, if 36, the outside diameter, be multiplied by 5·25+1= 6·25, which is the length increased by 1, the result is 225, which is the numeral; then opposite 100, the pressure, in Column A, of table No. 73, 225 is found, and at the head of the table the thickness is ½ inch, which is the least thickness the plate should be. If the nearest numeral had been in excess of 225, the next higher numeral found opposite 100, the pressure stipulated for, and in Column A, would be the right one to use; for instance, had it been 247, the next higher number found opposite 100, the pressure, is 254, and in the column under the distinguishing letter A, applicable to the circumstances of the case in the example, the thickness of the plate at the head of the table is $^{17}/_{32}$ inch: therefore, the plates would have been required to be practically $^{17}/_{32}$ inch thick.

Furnaces which are found to be too weak may be materially trengthened, so as to be fit for greater pressures, by fitting rings, as roperly fitted rings are equivalent to shortening the length.

(5) If a furnace be *vertical*, its diameter should not exceed ·9 of that uitable for a *horizontal* one of the same dimensions, in other respects nd constructed in the same manner.

Thus, if 36 inches is the proper diameter for a *horizontal* furnace, then,

$$36 \times \cdot 9 = 32 \cdot 4 = D,$$

is the outside diameter, in inches, which the *vertical* furnace should be.

(6) In finding the length of a *vertical* furnace, the appropriate numeral for a *horizontal* one, of the same dimensions and constructed in the same manner, should be multiplied by ·9.

Thus, if 225 be the appropriate numeral for a *horizontal* furnace, and 36 inches the outside diameter,

then,
$$\frac{\cdot 9 \times 225}{36} - 1 = 4 \cdot 625 = L,$$

which is the length the *vertical* furnace should be.

(7) In finding the pressure for a *vertical* furnace, the numeral is found by multiplying the length in feet, *plus* 1, by the outside diameter in inches and by ·9. Then, opposite the numeral the pressure will be found in the same way as for a *horizontal* furnace.

(8) In determining the thickness of a *vertical* furnace, having found the numeral by multiplying the length in feet, *plus* 1, by the diameter in inches and *dividing* the result by ·9, the nearest numeral (which should not be less), should be looked for opposite the pressure in the tables and in the column under the distinguishing letter applicable to the construction of the furnace, and the thickness is that at the head of the table.

When the diameter of a *vertical* furnace does not decrease 1 in 12, instead of using the number ·9, alluded to in the former paragraphs, it should be ·85; and if the furnace is parallel, it should not exceed ·8.

Iron Plates $\frac{5}{16}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.						
	A1†A N	B N	C N	D N	E N	F N	G N
lbs.							
5	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...
15	586	553	521	488	456	423	391
20	439	415	391	366	342	317	293
25	352	332	313	293	273	254	234
30	293	277	260	244	228	212	195
35	251	237	223	209	195	181	167
40	220	208	195	183	171	159	146
45	195	184	174	163	152	141	130
50	176	166	156	146	137	127	117
55	160	151	142	133	124	115	107
60	146	138	130	122	114	106	97·7
65	135	128	120	113	105	97·7	90·1
70	126	119	112	105	97·7	90·7	83·7
75	117	111	104	97·7	91·1	84·6	78·1
80	110	104	97·7	91·6	85·4	79·3	73·2
85	103	97·7	91·9	86·2	80·4	74·7	68·9
90	97·7	92·2	86·8	81·4	76	70·5	65·1
95	92·5	87·4	82·2	77·1	72	66·8	61·7
100	87·9	83	78·1	73·2	68·4	63·5	58·6
105	83·7	79·1	74·4	69·8	65·1	60·5	55·8
110	79·9	75·5	71	66·6	62·1	57·7	53·3
115	76·4	72·2	67·9	63·7	59·4	55·2	51
120	73·2	69·2	65·1	61	57	52·9	48·8
125	70·3	66·4	62·5	58·6	54·7	50·8	46·9
130	67·6	63·9	60·1	56·3	52·6	48·8	45·1
135	65·1	61·5	57·9	54·3	50·6	47	43·4
140	62·8	59·3	55·8	52·3	48·8	45·3	41·9
145	60·6	57·2	53·9	50·5	47·1	43·8	40·4
150	58·6	55·3	52·1	48·8	45·6	42·3	39·1
155	56·7	53·6	50·4	47·3	44·1	41	37·8
160	54·9	51·9	48·8	45·8	42·7	39·7	36·6

The length L should never exceed 10 ft. and $\frac{N}{D} - 1$ should not be more tha

* The diameter D should *not* be greater for any given pressure than opposite the given pressure in this table, but *may be less*.

† When A1 is the distinguishing letter Table No. 78 may be used wh length does not exceed 2·515 feet.

The numeral N should always be taken from the column under the guishing letter applicable to the case and opposite the given pressure.

D=Diameter of furnace in inches. N=Numeral applicable to the c

L=Length of furnace in feet. $\frac{N}{D} - 1 = L.$ $\frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL. TABLE No. 68.

Iron Plates $\frac{11}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Numerals.							
A1†A N	B N	C N	D N	E N	F N	G N	Maximum Diam.*
							ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
532	502	473	443	414	384	354	71
425	402	378	354	331	307	284	70
354	335	315	295	276	256	236	66·67
304	287	270	253	236	219	203	62·5
266	251	236	222	207	192	177	58·83
236	223	210	197	184	171	158	55·56
213	201	189	177	165	154	142	52·63
193	183	172	161	150	140	129	50
177	167	158	148	138	128	118	45·83
164	155	145	136	127	118	109	42·31
152	143	135	127	118	110	101	39·29
142	134	126	118	110	102	94·5	36·67
133	126	118	111	103	96	88·6	34·38
125	118	111	104	97·3	90·4	83·4	32·35
118	112	105	98·5	91·9	85·3	78·8	30·56
112	106	99·5	93·3	87·1	80·8	74·6	29·95
106	100	94·5	88·6	82·7	76·8	70·9	27·5
101	95·7	90	84·4	78·8	73·1	67·5	26·19
96·7	91·3	85·9	80·6	75·2	69·8	64·5	25
92·5	87·3	82·2	77·1	71·9	66·8	61·7	23·91
88·6	83·7	78·8	73·9	68·9	64	59·1	22·92
85·1	80·4	75·6	70·9	66·2	61·4	56·7	22
81·8	77·3	72·7	68·2	63·6	59·1	54·5	21·15
78·8	74·4	70	65·6	61·3	56·9	52·5	20·37
76	71·7	67·5	63·3	59·1	54·9	50·6	19·64
73·3	69·3	65·2	61·1	57	53	48·9	18·97
70·9	67	63	59·1	55·1	51·2	47·3	18·33
68·6	64·8	61	57·2	53·4	49·6	45·7	17·74
66·5	62·8	59·1	55·4	51·7	48	44·3	17·19

length L should never exceed 10 ft. and $\frac{N}{D}-1$ should not be more than 10 ft.

ie diameter D should *not* be greater for any given pressure than that te the given pressure in this table, but *may be less*.

hen A1 is the distinguishing letter Table No. 78 may be used when the does not exceed 2·867 feet.

numeral N should always be taken from the column under the distinng letter applicable to the case and opposite the given pressure.

Diameter of furnace in inches. N=Numeral applicable to the case.

Length of furnace in feet. $\frac{N}{D}-1=L.$ $\frac{N}{L+1}=D.$

M

Iron Plates $\frac{3}{8}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.							Maxi-mum
	A1†A N	B N	C N	D N	E N	F N	G N	
lbs.								in
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...
25	506	478	450	422	394	366	338	71
30	422	398	375	352	328	305	281	70
35	362	342	321	301	281	261	241	66·
40	316	299	281	264	246	229	211	62·
45	281	266	250	234	219	203	188	58·
50	253	239	225	211	197	183	169	55·
55	230	217	205	192	179	166	153	52·
60	211	199	188	176	164	152	141	50
65	195	184	173	162	151	141	130	46
70	181	171	161	151	141	131	121	42
75	169	159	150	141	131	122	113	40
80	158	149	141	132	123	114	105	37
85	149	141	132	124	116	108	99·3	35
90	141	133	125	117	109	102	93·8	33
95	133	126	118	111	104	96·2	88·8	31
100	127	120	113	105	98·4	91·4	84·4	30
105	121	114	107	100	93·8	87·1	80·4	28
110	115	109	102	95·9	89·5	83·1	76·7	27
115	110	104	97·8	91·7	85·6	79·5	73·4	26
120	105	99·6	93·8	87·9	82	76·2	70·3	25
125	101	95·6	90	84·4	78·8	73·1	67.5	24
130	97·4	91·9	86·5	81·1	75·7	70·3	64·9	2[illegible]
135	93·8	88·5	83·3	78·1	72·9	67·7	62·5	2[illegible]
140	90·4	85·4	80·4	75·3	70·3	65·3	60·3	21
145	87·3	82·4	77·6	72·7	67·9	63	58·2	20
150	84·4	79·7	75	70·3	65·6	60·9	56·3	20
155	81·7	77·1	72·6	68	63·5	59	54·4	1[illegible]
160	79·1	74·7	70·3	65·9	61·5	57·1	52·7	1[illegible]

The length L should never exceed 10 ft. and $\frac{N}{D} - 1$ should not be more than

* The diameter D should *not* be greater for any given pressure than opposite the given pressure in this table, but *may be less*.

† When A1 is the distinguishing letter Table No. 78 may be used when length does not exceed 3·218 feet.

The numeral N should always be taken from the column under the di guishing letter applicable to the case and opposite the given pressure.

D = Diameter of furnace in inches. N = Numeral applicable to the cas

L = Length of furnace in feet. $\frac{N}{D} - 1 = L.$ $\frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL. TABLE No. 70.

Iron Plates $\frac{13}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Numerals.							Maximum Diam.*
A1†A N	B N	C N	D N	E N	F N	G N	
							ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
495	468	440	413	385	358	330	71
424	401	377	354	330	307	283	70
371	351	330	309	289	268	248	66·67
330	312	293	275	257	238	220	62·5
297	281	264	248	231	215	198	58·83
270	255	240	225	210	195	180	55·56
248	234	220	206	193	179	165	52·63
229	216	203	190	178	165	152	50
212	200	189	177	165	153	141	46·43
198	187	176	165	154	143	132	43·33
186	175	165	155	144	134	124	40·63
175	165	155	146	136	126	116	38·24
165	156	147	138	128	119	110	36·11
156	148	139	130	122	113	104	34·21
149	140	132	124	116	107	99	32·5
141	134	126	118	110	102	94·3	30·95
135	128	120	113	105	97·5	90	29·55
129	122	115	108	100	93·3	86·1	28·26
124	117	110	103	96·3	89·4	82·5	27·08
119	112	106	99	92·4	85·8	79·2	26
114	108	102	95·2	88·9	82·5	76·2	25
110	104	97·8	91·7	85·6	79·5	73·4	24·07
106	100	94·3	88·4	82·5	76·6	70·7	23·21
102	96·7	91·1	85·4	79·7	74	68·3	22·41
99	93·5	88	82·5	77	71·5	66	21·67
95·8	90·5	85·2	79·9	74·5	69·2	63·9	20·97
92·8	87·7	82·5	77·4	72·2	67	61·9	20·31

length L should never exceed 10 ft. and $\frac{N}{D}-1$ should not be more than 10 ft.

e diameter D should *not* be greater for any given pressure than that ite the given pressure in this table, but *may be less.*

hen A1 is the distinguishing letter Table No. 78 may be used when the does not exceed 3·57 feet.

numeral N should always be taken from the column under the distin- ng letter applicable to the case and opposite the given pressure.

=Diameter of furnace in inches. N = Numeral applicable to the case.

Length of furnace in feet. $\frac{N}{D}-1=L.$ $\frac{N}{L+1}=D.$

Iron Plates $\frac{7}{16}$ inch thick.
Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.							Maxi-
	A1†A N	B N	C N	D N	E N	F N	G N	
lbs.								
5	...	...	...	...	...	...	...	
10	...	...	...	...	...	...	...	
15	...	...	...	...	...	...	...	
20	...	...	...	...	...	...	...	
25	...	...	...	...	...	...	...	
30	...	...	...	...	...	...	...	
35	492	465	438	410	383	355	328	
40	431	407	383	359	335	311	287	
45	383	362	340	319	298	276	255	
50	345	325	306	287	268	249	230	
55	313	296	278	261	244	226	209	
60	287	271	255	239	223	207	191	
65	265	250	236	221	206	191	177	
70	246	232	219	205	191	178	164	
75	230	217	204	191	179	166	153	
80	215	203	191	179	167	156	144	
85	203	191	180	169	158	146	135	
90	191	181	170	160	149	138	128	
95	181	171	161	151	141	131	121	
100	172	163	153	144	134	124	115	
105	164	155	146	137	128	118	109	
110	157	148	139	131	122	113	104	
115	150	141	133	125	117	108	99·9	
120	144	136	128	120	112	104	95·7	
125	138	130	123	115	107	99·5	91·9	
130	133	125	118	110	103	95·7	88·3	
135	128	121	113	106	99·2	92·2	85·1	
140	123	116	109	103	95·7	88·9	82	
145	119	112	106	99	92·4	85·8	79·2	
150	115	108	102	95·7	89·3	82·9	76·6	
155	111	105	98·8	92·6	86·4	80·3	74·1	
160	108	102	95·7	89·7	83·7	77·8	71·8	

The length L should never exceed 10 ft. and $\frac{N}{D}-1$ should not be more tha

* The diameter D should *not* be greater for any given pressure tha opposite the given pressure in this table, but *may be less.*

† When A1 is the distinguishing letter Table No. 78 may be used wh length does not exceed 3·921 feet.

The numeral N should always be taken from the column under the guishing letter applicable to the case and opposite the given pressure.

D=Diameter of furnace in inches. N=Numeral applicable to the c

L=Length of furnace in feet. $\frac{N}{D}-1=L.$ $\frac{N}{L+1}=D.$

FURNACES PLAIN CYLINDRICAL. TABLE No. 72.

Iron Plates $\frac{15}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.							Maximum Diam.*
	A1†A N	B N	C N	D N	E N	F N	G N	
lbs.								ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...
40	494	467	439	412	385	357	330	71
45	439	415	391	366	342	317	293	70
50	396	374	352	330	308	286	264	66·67
55	360	340	320	300	280	260	240	62·5
60	330	311	293	275	256	238	220	58·83
65	304	287	270	254	237	220	203	55·56
70	283	267	251	235	220	204	188	52·63
75	264	249	234	220	205	190	176	50
80	247	233	220	206	192	179	165	46·88
85	233	220	207	194	181	168	155	44·12
90	220	208	195	183	171	159	146	41·67
95	208	197	185	173	162	150	139	39·47
100	198	187	176	165	154	143	132	37·5
105	188	178	167	157	146	136	126	35·71
110	180	170	160	150	140	130	120	34·09
115	172	162	153	143	134	124	115	32·61
120	165	156	146	137	128	119	110	31·25
125	158	149	141	132	123	114	105	30
130	152	144	135	127	118	110	101	28·85
135	146	138	130	122	114	106	97·7	27·78
140	141	133	126	118	110	102	94·2	26·79
145	136	129	121	114	106	98·5	90·9	25·86
150	132	125	117	110	103	95·2	87·9	25
155	128	120	113	106	99·2	92·1	85·1	24·19
160	124	117	110	103	96·1	89·3	82·4	23·44

The length L should never exceed 10 ft. and $\frac{N}{D}-1$ should not be more than 10 ft.

* The diameter D should *not* be greater for any given pressure than that opposite the given pressure in this table, but *may be less.*

† When A1 is the distinguishing letter Table No. 78 may be used when the length does not exceed 4·273 feet.

The numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

D = Diameter of furnace in inches. N = Numeral applicable to the case.

L = Length of furnace in feet. $\frac{N}{D}-1=L.$ $\frac{N}{L+1}=D$

Iron Plates $\frac{1}{2}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.							Maximum Diam.*
	A1†A N	B N	C N	D N	E N	F N	G N	
lbs.								ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...
45	500	472	444	417	389	361	333	71
50	450	425	400	375	350	325	300	70
55	409	386	364	341	318	295	273	66·67
60	375	354	333	313	292	271	250	62·5
65	346	327	308	288	269	250	231	58·83
70	321	304	286	268	250	232	214	55·56
75	300	283	267	250	233	217	200	52·63
80	281	266	250	234	219	203	188	50
85	265	250	235	221	206	191	176	47·06
90	250	236	222	208	194	181	167	44·44
95	237	224	211	197	184	171	158	42·11
100	225	213	200	188	175	163	150	40
105	214	202	190	179	167	155	143	38·1
110	205	193	182	170	159	148	136	36·36
115	196	185	174	163	152	141	130	34·78
120	188	177	167	156	146	135	125	33·33
125	180	170	160	150	140	130	120	32
130	173	163	154	144	135	125	115	30·77
135	167	157	148	139	130	120	111	29·63
140	161	152	143	134	125	116	107	28·57
145	155	147	138	129	121	112	103	27·59
150	150	142	133	125	117	108	100	26·67
155	145	137	129	121	113	105	96·8	25·81
160	141	133	125	117	109	102	93·8	25

The length L should never exceed 10 ft., and $\frac{N}{D}-1$ should not be more than 10 ft.

* The diameter D should *not* be greater for any given pressure than that opposite the given pressure in this table, but *may be less*.

† When A1 is the distinguishing letter, Table No. 78 may be used when the length does not exceed 4·625 feet.

The numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

D = Diameter of furnace in inches. N = Numeral applicable to the case.

L = Length of furnace in feet. $\frac{N}{D}-1 = L.$ $\frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL. TABLE No. 74.

Iron Plates $\frac{17}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Numerals.							Maximum Diam.*
A1†A N	B N	C N	D N	E N	F N	G N	ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
508	480	452	423	395	367	339	71
462	436	411	385	359	334	308	70
423	400	376	353	329	306	282	66·67
391	369	347	326	304	282	261	62·5
363	343	323	302	282	262	242	58·83
339	320	301	282	263	245	226	55·56
318	300	282	265	247	229	212	52·63
299	282	266	249	232	216	199	50
282	267	251	235	220	204	188	47·22
267	253	238	223	208	193	178	44·74
254	240	226	212	198	183	169	42·5
242	228	215	202	188	175	161	40·48
231	218	205	192	180	167	154	38·64
221	209	196	184	172	160	147	36·96
212	200	188	176	165	153	141	35·42
203	192	181	169	158	147	135	34
195	185	174	163	152	141	130	32·69
188	178	167	157	146	136	125	31·48
181	171	161	151	141	131	121	30·36
175	165	156	146	136	127	117	29·31
169	160	151	141	132	122	113	28·33
164	155	146	137	127	118	109	27·42
159	150	141	132	123	115	106	26·56

length L should never exceed 10 ft., and $\frac{N}{D} - 1$ should not be more than 10 ft.

e diameter D should *not* be greater for any given pressure than that
ite the given pressure in this table, but *may be less.*
hen A1 is the distinguishing letter, Table No. 78 may be used when the
does not exceed 4·976 feet.
numeral N should always be taken from the column under the distin-
ng letter applicable to the case and opposite the given pressure.
Diameter of furnace in inches. N = Numeral applicable to the case.
Length of furnace in feet. $\frac{N}{D} - 1 = L.$ $\frac{N}{L+1} = D.$

Iron Plates $\frac{9}{16}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.							Maximum Diam.*
	A1†A N	B N	C N	D N	E N	F N	G N	
lbs.								ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	..	...	...	...
20	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...
35	...	...	..	...	...	...	...	...
40	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...
55	518	489	460	431	403	374	345	71
60	475	448	422	396	369	343	316	70
65	438	414	389	365	341	316	292	66·67
70	407	384	362	339	316	294	271	62·5
75	380	359	338	316	295	274	253	58·83
80	356	336	316	297	277	257	237	55·56
85	335	316	298	279	261	242	223	52·63
90	316	299	281	264	246	229	211	50
95	300	283	266	250	233	216	200	47·37
100	285	269	253	237	221	206	190	45
105	271	256	241	226	211	196	181	42·86
110	259	244	230	216	201	187	173	40·91
115	248	234	220	206	193	179	165	39·13
120	237	224	211	198	185	171	158	37·5
125	228	215	203	190	177	165	152	36
130	219	207	195	183	170	158	146	34·62
135	211	199	188	176	164	152	141	33·33
140	203	192	181	170	158	147	136	32·14
145	196	185	175	164	153	142	131	31·03
150	190	179	169	158	148	137	127	30
155	184	174	163	153	143	133	122	29·03
160	178	168	158	148	138	129	119	28·13

The length L should never exceed 10 ft. and $\frac{N}{D} - 1$ should not be more than 10 ft.

* The diameter D should *not* be greater for any given pressure than that opposite the given pressure in this table, but *may be less*.

† When A1 is the distinguishing letter Table No. 78 may be used when the length does not exceed 5·328 feet.

The numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

D = Diameter of furnace in inches. N = Numeral applicable to the case.

L = Length of furnace in feet. $\frac{N}{D} - 1 = L.$ $\frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL. Table No. 76.

Iron Plates $\frac{21}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.							Maxi-mum Diam.*
	A1† A / N	B / N	C / N	D / N	E / N	F / N	G / N	
lbs.								ins.
5	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—
15	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	—
25	—	—	—	—	—	—	—	—
30	—	—	—	—	—	—	—	—
35	—	—	—	—	—	—	—	—
40	—	—	—	—	—	—	—	—
45	—	—	—	—	—	—	—	—
50	—	—	—	—	—	—	—	—
55	—	—	—	—	—	—	—	—
60	529	499	470	442	411	382	353	71
65	488	461	434	407	380	353	325	70
70	453	428	403	378	353	327	302	66·67
75	423	400	376	353	329	306	282	62·5
80	397	375	353	331	308	286	264	58·83
85	373	353	332	311	290	270	249	55·56
90	353	333	313	294	274	255	235	52·63
95	334	315	297	278	260	241	223	50
100	317	300	282	264	247	229	212	47·5
105	302	285	269	252	235	218	201	45·24
110	288	272	256	240	224	208	192	43·18
115	276	261	245	230	215	199	184	41·30
120	264	250	235	220	206	191	176	39·58
125	254	240	226	212	197	183	169	38
130	244	231	217	203	190	176	163	36·54
135	235	222	209	196	183	170	157	35·19
140	227	214	201	189	176	164	151	33·93
145	219	207	195	182	170	158	146	32·76
150	212	200	188	176	165	153	141	31·67
155	205	193	182	171	159	148	136	30·65
160	198	187	176	165	154	143	132	29·69

The length L should never exceed 10 ft. and $\frac{N}{D}-1$ should not be more than 10 ft.

* The diameter D should *not* be greater for any given pressure than that opposite the given pressure in this table, but *may be* less.

† When A1 is the distinguishing letter Table No. 75 may be used when the length does not exceed 5·679 feet.

The numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

D = Diameter of furnace in inches. N = Numeral applicable to the case.

L = Length *of furnace in feet.* $\frac{N}{D}-1=L.$ $\frac{N}{L+1}=D.$

FURNACES PLAIN CYLINDRICAL. T

Iron Plates $\frac{5}{8}$ inch thick.

Pressures and Numerals for Lengths and Diame

Pressure per sq. in.	Numerals					
	A1*A N	B N	C N	D N	E N	F N
lbs. 5	—	—	—	—	—	—
10	—	—	—	—	—	—
15	—	—	—	—	—	—
20	—	—	—	—	—	—
25	—	—	—	—	—	—
30	—	—	—	—	—	—
35	—	—	—	—	—	—
40	—	—	—	—	—	—
45	—	—	—	—	—	—
50	—	—	—	—	—	—
55	—	—	—	—	—	—
60	—	—	—	—	—	—
65	541	511	481	451	421	391
70	502	474	446	419	391	363
75	469	443	417	391	365	339
80	439	415	391	366	342	317
85	414	391	368	345	322	299
90	391	369	347	326	304	282
95	370	350	329	308	288	267
100	352	332	313	293	273	254
105	335	316	298	279	260	242
110	320	302	284	266	249	231
115	306	289	272	255	238	221
120	293	277	260	244	228	212
125	281	266	250	234	219	203
130	270	255	240	225	210	195
135	260	246	231	217	203	188
140	251	237	223	209	195	181
145	242	229	216	202	189	175
150	234	221	208	195	182	169
155	227	214	202	189	176	164
160	220	208	195	183	171	159

The length L should never exceed 20 ft., and $\frac{N}{D} - 1$ should not be

* The diameter D should not be greater for any given pre opposite the given pressure in this table, but *may be less.*

† When A1 is the distinguishing letter, Table No. 78 may be length does not exceed 6·021 feet.

The numeral N should always be taken from the column u guishing letter applicable to the case and opposite the given pr

D = Diameter of furnace in inches. N = Numeral applicabl

L = Length of furnace in feet. $\frac{N}{D} - 1 = L$. $\frac{N}{L+1} =$

FURNACES WITH FLANGED JOINTS.

Iron Plates from ¼ inch to ⅝ inch thick.

Following these notes is a table specially intended for furnaces of ordinary diameters, made of rings welded longitudinally and flanged at the ends, and, when there is more than one ring, riveted together so as to form a complete furnace, and for furnaces whose length is equal to or shorter than that given opposite the thickness, being dealt with and found in the column "maximum lengths for thickness."

This table is only intended for furnaces made of the *highest* quality of iron, and when the length, or the distance, between the centres of flanges of the rings, when they are made of more than one ring, does not exceed that given in the column headed "maximum lengths for thickness;" when the length, or the distance, between the rings exceeds that given, the pressure or other particulars should be found from the Tables No. 65 to 78.

N = Numeral for pressure.
C = Constant for thickness.
D = Diameter of furnace, in inches, outside.
l = Length or distance between centres of flanges, in inches.
B = Working pressure, in lbs., per square inch.

$$\frac{C-l}{N} = D.$$

$$C-ND = l.$$

$$ND+l = C.$$

$$\frac{C-l}{D} = N.$$

(1) The maximum diameter a furnace should be for a given working pressure, if the thickness of iron plate and the length, or the distance, in inches, between the centres of the flanges be known, may be found by subtracting the length, or the distance, between the centres of flanges, *in inches*, from the thickness constant opposite the *given* thickness, and dividing the result by the numeral opposite the *given* pressure; or, the diameter should not exceed $\frac{C-l}{N}$.

If the thickness of the iron plates of a furnace be ⁹⁄₁₆ inch, the length, or the distance, between the centres of flanges 24 inches, the pressure required 150 lbs., and the maximum diameter has to be determined:—

Then, if 24, the length, or distance, in inches, between the centres of flanges, be subtracted from 177·843, the constant found *opposite the thickness*, and the remainder divided by 3·7968, the

Iron Plates $\frac{5}{8}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals A1†A N	B N	C N	D N	E N	F N	G N	Maximum Diam.*
lbs.								ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...
65	541	511	481	451	421	391	361	71
70	502	474	446	419	391	363	335	70
75	469	443	417	391	365	339	313	66·67
80	439	415	391	366	342	317	293	62·5
85	414	391	368	345	322	299	276	58·83
90	391	369	347	326	304	282	260	55·56
95	370	350	329	308	288	267	247	52·63
100	352	332	313	293	273	254	234	50
105	335	316	298	279	260	242	223	47·62
110	320	302	284	266	249	231	213	45·45
115	306	289	272	255	238	221	204	43·48
120	293	277	260	244	228	212	195	41·67
125	281	266	250	234	219	203	188	40
130	270	255	240	225	210	195	180	38·46
135	260	246	231	217	203	188	174	37·04
140	251	237	223	209	195	181	167	35·71
145	242	229	216	202	189	175	162	34·48
150	234	221	208	195	182	169	156	33·33
155	227	214	202	189	176	164	151	32·26
160	220	208	195	183	171	159	146	31·25

The length L should never exceed 10 ft., and $\frac{N}{D} - 1$ should not be more than 10 ft.

* The diameter D should *not* be greater for any given pressure than that opposite the given pressure in this table, but *may be less*.

† When A1 is the distinguishing letter, Table No. 78 may be used when the length does not exceed 6·031 feet.

The numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

D = Diameter of furnace in inches. N = Numeral applicable to the case.

L = Length of furnace in feet. $\frac{N}{D} - 1 = L.$ $\frac{N}{L+1} = D.$

FURNACES WITH FLANGED JOINTS.

Iron Plates from ¼ inch to ⅝ inch thick.

lowing these notes is a table specially intended for furnaces of ıry diameters, made of rings welded longitudinally and flanged at ıds, and, when there is more than one ring, riveted together so form a complete furnace, and for furnaces whose length is equal to rter than that given opposite the thickness, being dealt with and in the column "maximum lengths for thickness."

s table is only intended for furnaces made of the *highest* quality ı, and when the length, or the distance, between the centres of s of the rings, when they are made of more than one ring, does ceed that given in the column headed "maximum lengths for ıess;" when the length, or the distance, between the rings exceeds given, the pressure or other particulars should be found from the No. 65 to 78.

Numeral for pressure.
Constant for thickness.
Diameter of furnace, in inches, outside.
Length or distance between centres of flanges, in inches.
Working pressure, in lbs., per square inch.

$$\frac{C-l}{N} = D.$$

$$C - ND = l.$$

$$ND + l = C.$$

$$\frac{C-l}{D} = N.$$

The maximum diameter a furnace should be for a given working re, if the thickness of iron plate and the length, or the distance, hes, between the centres of the flanges be known, may be found btracting the length, or the distance, between the centres of s, *in inches*, from the thickness constant opposite the *given* ıess, and dividing the result by the numeral opposite the *given* re; or, the diameter should not exceed $\frac{C-l}{N}$.

he thickness of the iron plates of a furnace be $^9/_{16}$ inch, the , or the distance, between the centres of flanges 24 inches, essure required 150 lbs., and the maximum diameter has to be ıined:—

Then, if 24, the length, or distance, in inches, between the ntres of flanges, be subtracted from 177·843, the constant found *pposite the thickness,* and the remainder divided by 3·7968, the

numeral found opposite the pressure, 150, the result is the maximum outside diameter the furnace should be,

$$\text{or } \frac{177 \cdot 843 - 24}{3 \cdot 7968} = 40 \cdot 52 = D,$$

or, say, 40½ inches.

(2) The maximum length, or the distance, in inches, between the centres of the flanges of a furnace, can be determined if the working pressure, thickness of iron plates, and diameter are known, by multiplying the numeral, opposite the given pressure, by the diameter and subtracting the product from the thickness constant opposite the given thickness; or, the length, or distance, in inches, between the centres of flanges, should not exceed $C - ND$.

If the working pressure is required to be 135 lbs., the thickness of the iron plate ½ inch, and the outside diameter 31 inches, and the maximum length, or distance, in inches, between the centres of flanges has to be determined:—

Then if 3·4171, the numeral found opposite the pressure, 135, be multiplied by 31, the diameter, and the product subtracted from 156·75, the constant found opposite the thickness, ½, the remainder is the maximum length, or distance, in inches, between the centres of the flanges,

$$\text{or, } 3 \cdot 4171 \times 31 = 105 \cdot 93,$$
$$\text{and } 156 \cdot 75 - 105 \cdot 93 = 50 \cdot 82 = l,$$

or the maximum length should be, say, 50¾ inches.

(3) The minimum thickness of iron plates of a furnace can be determined if the working pressure, diameter and length, or distance, in inches, between the centres of the flanges, be known, by adding the length, or distance, in inches, between the centres of the flanges to the product of the diameter and the numeral opposite the given pressure; or, the thickness constant should not exceed $ND + l$.

If the working pressure is required to be 100 lbs., the outside diameter 36 inches, and the length, or distance, between the centres of flanges 24 inches, and the minimum thickness of the iron plate has to be determined:—

Then if 24, the length, be added to the product of 2·5312, the numeral found opposite 100, the working pressure, and 36, the diameter, the result is 115·1, which is practically the constant found opposite ⅜, the thickness,

$$\text{or, } 2 \cdot 5312 \times 36 + 24 = 115 \cdot 1 = C,$$

which gives ⅜ inch, the thickness of the plate.

(4) The working pressure for a furnace made of iron plates, if the thickness, diameter, and length, or distance, in inches, between the *centres of* the flanges, is known, may be found opposite the numeral *obtained by* subtracting the length, in inches, from the thickness

›nstant, opposite the given thickness, and dividing by the diameter; :, the numeral should not be greater than $\frac{C-l}{D}$.

(5) If the thickness of the iron plate be $\frac{7}{16}$ inch, the outside diameter 3 inches, and the length, or distance, between the centres of the anges 20 inches, and the working pressure is required to be etermined:—

Then, if 20, the length, or distance, in inches, between the centres of the flanges, be subtracted from 135·656, the constant opposite $\frac{7}{16}$, the thickness, and the remainder divided by 36, the diameter, the result is the numeral opposite which the working pressure is found,

$$\text{or, } 135{\cdot}656 - 20 = 115{\cdot}656,$$

$$\text{and } \frac{115{\cdot}656}{36} = 3{\cdot}212 = N,$$

which is slightly in excess of the numeral found opposite 125 lbs. pressure; therefore, the working pressure is, say, 125 lbs. — B.

When furnaces are made with flanged joints, it is well to have the ıdius of the flange on the fire side about 1·5 inch.

The flanges should be kept as near the original thickness of the late as is practicable, and after all heating, welding, and flanging is ›mpleted, the lengths should be efficiently annealed before being veted. If there are any signs of defects in the flanging, the defective ngth should not on any account be used.

The distance between the edges of the rivet holes to the edges of the ange should not be less than the diameter of the rivet. The rivets ıould be of good size, the diameter at least ⅛ inch more than the ıickness of the plates, and the heads should not be too large. The ›pth of the strip or ring between the flanges should not be less than ıree times the diameter of the rivets, and the thickness may be about ıe half the thickness of the furnace plates. To make a first-class job ıe ring should be turned.

The holes in the flanges should be drilled; but when not drilled in ace, they should be drilled sufficiently less in diameter to insure that hen rimered out, fair and perfect holes are formed. It is advisable › have a little taper in the holes in each flange; this will allow the ›ads of the rivets to be kept of moderate size.

Iron Plates from $\frac{1}{4}$ inch to $\frac{5}{8}$ inch thick.

Pressure per sq. in.	Pressure Numerals.	Constants and Maximum Lengths f… Thicknesses which they are oppo…		
		Thickness.	Constants.	*M… Len… Thic…
lbs.	N.	Inches.	C	
5	...			
10	...			
15	...			
20	...			
25	...			
30	...			
35	...	¼	72·375	2
40	1·0125			
45	1·1390625	$^{9}/_{32}$	82·921875	2
50	1·265625			
55	1·3921875	$^{5}/_{16}$	93·46875	3
60	1·51875			
65	1·6453125	$^{11}/_{32}$	104·015625	3
70	1·771875			
75	1·8984375	⅜	114·5625	3
80	2·025			
85	2·1515625	$^{13}/_{32}$	125·109375	4
90	2·278125			
95	2·4046875	$^{7}/_{16}$	135·65625	4
100	2·53125			
105	2·6578125	$^{15}/_{32}$	146·203125	5
110	2·784375			
115	2·9109375	½	156·75	5
120	3·0375			
125	3·1640625	$^{17}/_{32}$	167·296875	5
130	3·290625			
135	3·4171875	$^{9}/_{16}$	177·84375	6
140	3·54375			
145	3·6703125	$^{19}/_{32}$	188·390625	6
150	3·796875			
155	3·9234375	⅝	198·9375	7
160	4·05			

* The lengths opposite the thickness in each case are the maximum in inches, between the centres of the flanges, for which the Tables s… used. When the length exceeds that opposite the given thickness pressure may be found from Tables Nos. 65 to 77.

N = Pressure numeral. C = Thickness constant. D = Diameter, outside, l = Length between centres of flanges, in inches.

$$\frac{C-l}{N} = D. \quad C-ND = l. \quad ND+l = C. \quad \frac{C-l}{D} = \ldots$$

'URNACES, CORRUGATED, CYLINDRICAL.

Iron Plates from ¼ inch to ⅝ inch thick.

ıe Tables Nos. 79 and 80, immediately following these remarks, ximum diameter, the working pressure, and the thickness of the an be determined when the plates, of which the furnaces are ıre of the *highest* quality.

tables are only intended for furnaces which are machine-made en the pitch of the corrugations is 6 inches, the depth from top ugation outside, to bottom of corrugation inside, not less than s, and the plain parts at the ends not more than 6 inches in When the corrugations are not made by machine, the working e should not be so great as that found by the tables, as furnaces, hey are not corrugated by a machine, are not so reliable.

mean diameter, for the purpose of determining the pressure or ss, is half the sum of the two outside diameters, the one being easured from the top of the corrugations, the other from the of the corrugations; or, the sum of the maximum and minimum ers inside, *plus* four times the thickness of the plate divided by uals the mean diameter.

Mean diameter, in inches.
Thickness, in inches.
Working pressure, in lbs., per square inch.

maximum mean diameter, in inches, to which corrugated s should be made, if constructed of iron plates of the *highest* , the thickness of plate and the working pressure being deter- is found in the column under the given thickness of plate, and e the given pressure; or if the pressure and diameter be deter- the thickness to which the plate should be made is found at d of the column above the given diameter, opposite the given e; or the pressure for a known thickness and diameter is that opposite such diameter in the column under the given thick-

e pressure is required to be 100 lbs., and the thickness of the te is ½ inch, and the maximum mean diameter is required:—

Then, opposite 100 lbs., the pressure, and in the column under inch, the thickness, 45 is found, which is the maximum mean ımeter in inches.

$$45 = D.$$

e pressure is required to be 100 lbs., the mean diameter 45 inches, thickness of the iron plate has to be determined:—

Then, opposite 100 lbs., the pressure, 45, the diameter, is ınd in the column under ½ inch, which is the minimum ckness the iron plate should be,

$$\tfrac{1}{2} \text{ inch} = T.$$

If the working pressure has to be determined when the thickness of the iron plate is ½ inch and the mean diameter is 45 inches:—

Then, in the column under ½ inch, the thickness, 45, the diameter, is found, and opposite it the pressure is 100 lbs. which is the maximum working pressure in lbs.

100 = B.

If the plates of which iron corrugated furnaces are made, are not entirely free from laminations, they will be sure to become defective at a very early period of their existence.

FURNACES, CORRUGATED, CYLINDRICAL. Iron Plates from ¼ inch to 7/16 inch thick. Pressures and Diameters when *Machine* made.

TABLE No. 79.

Thicknesses and Diameters.*						
¼ in.	9/32 in.	5/16 in.	11/32 in.	⅜ in.	13/32 in.	7/16 in.
Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
56·25	...	...	...	...	...	...
50·0	56·25	...	...	...	...	...
45·0	50·62	56·25	...	...	...	...
40·9	46·02	51·13	56·25	...	...	...
37·5	42·18	46·87	51·56	56·25	...	...
34·61	38·94	43·26	47·59	51·92	56·25	...
32·14	36·16	40·17	44·19	48·21	52·23	56·25
30·0	33·75	37·5	41·25	45·0	48·75	52·5
28·12	31·64	35·15	38·67	42·18	45·7	49·21
26·47	29·77	33·08	36·39	39·70	43·01	46·32
25·0	28·12	31·25	34·37	37·5	40·62	43·75
23·68	26·64	29·60	32·56	35·52	38·48	41·44
22·5	25·31	28·12	30·93	33·75	36·56	39·37
21·42	24·10	26·78	29·46	32·14	34·82	37·5
20·45	23·01	25·56	28·12	30·68	33·23	35·79
19·56	22·01	24·45	26·90	29·34	31·79	34·23
18·75	21·09	23·43	25·78	28·12	30·46	32·81
18·0	20·25	22·5	24·75	27·0	29·25	31·5
17·3	19·47	21·63	23·79	25·96	28·12	30·28
16·66	18·75	20·83	22·91	25·0	27·08	29·16
16·07	18·08	20·08	22·09	24·10	26·11	28·12
15·51	17·45	19·39	21·33	23·27	25·21	27·15
15·0	16·87	18·75	20·62	22·5	24·37	26·25
14·51	16·33	18·14	19·95	21·77	23·58	25·4
14·06	15·82	17·57	19·33	21·09	22·85	24·6

The diameter is the *mean* diameter, which is half the sum of outside diameters, the one being that measured from the top of *corrugations, the other* from the bottom of the corrugations.

Iron Plates from $^{15}/_{32}$ inch to $^5/_8$ inch thick.

Pressures and Diameters when *Machine* made.

Pressure per square inch.	Thicknesses and Diameters.*					
	$^{15}/_{32}$ in.	$^1/_2$ in.	$^{17}/_{32}$ in.	$^9/_{16}$ in.	$^{19}/_{32}$ in.	5
	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Di in i
lbs.						
5	...	...	...	...	...	
10	...	...	...	...	...	
15	...	...	...	...	...	
20	...	...	...	...	...	
25	...	...	...	...	...	
30	...	...	...	...	...	
35	...	...	...	...	...	
40	...	...	...	...	...	
45	...	...	...	...	...	
50	...	...	...	...	...	
55	...	...	...	...	...	
60	...	...	...	...	...	
65	...	...	...	...	...	
70	...	...	...	...	...	
75	56·25	...	...	...	...	
80	52·73	56·25	...	...	...	
85	49·63	52·94	56·25	...	...	
90	46·87	50·0	53·12	56·25	...	
95	44·40	47·36	50·32	53·28	56·25	
100	42·18	45·0	47·81	50·62	53·43	5
105	40·17	42·85	45·53	48·21	50·89	5
110	38·35	40·90	43·46	46·02	48·57	5
115	36·68	39·13	41·57	44·02	46·46	4
120	35·15	37·5	39·84	42·18	44·53	4
125	33·75	36·0	38·25	40·5	42·75	4
130	32·45	34·61	36·77	38·94	41·1	4
135	31·25	33·33	35·41	37·5	39·58	4
140	30·13	32·14	34·15	36·16	38·16	4
145	29·09	31·03	32·97	34·91	36·85	3
150	28·12	30·0	31·87	33·75	35·62	3
155	27·21	29·03	30·84	32·66	34·47	3
160	26·36	28·12	29·88	31·64	33·39	3

* The diameter is the *mean* diameter, which is half the su the outside diameters, the one being that measured from the t *the corrugations*, the other from the bottom of the corrugations

FLAT SURFACES, PRESSURES, PITCHES, AND SURFACES.

Steel Plates.

the tables numbered from 81 to 109, which follow these notes and rks, pitches are given from about 21 inches to 3½ inches, and ces, from about 440 square inches to 12½ square inches, with the ness of plates and pressures suitable for the different pitches urfaces, according to the particular conditions under which the ures, pitches, and surfaces are applicable. The pressures range 5 lbs. to 160 lbs. per square inch. The thicknesses of the s range from ¼ to 1⅛ inch, each table advancing by $\frac{1}{32}$ of ch.

e following notes and remarks will facilitate the use of the s :—

e distinguishing letters over the different columns in each table, to the conditions under which the pitches and surfaces are ble for the working pressure, opposite the particular pitch and ce, when the plates are of the thickness given at the head of the ; and consequently opposite the particular pressure will be found itches and surfaces suitable for the working pressure for the ness of plate at the head of the table.

e following are the conditions to which each distinguishing letter e tables refers, showing under which distinguishing letter the es and surfaces should be looked for in the table for the suitable ness of plate.

guishing s. — Distinguishing Letters.

If the plates are *not* exposed to the impact of heat or flame, and the stays are fitted with nuts and strips of at least the thickness of the plates they cover, and of a width not less than ⅝ the pitch of the stays, and the strips are properly riveted to the outside of the plates, then the maximum working pressure is that found opposite the pitch or surface in column, ... A_1.

If the plates are *not* exposed to the impact of heat or flame, and the stays are fitted with nuts and washers of at least the thickness of the plates they cover, and of a diameter not less than ⅔ the pitch of the stays, and the washers are properly riveted on the outside of the plates, then the maximum working pressure is that found opposite the pitch or surface in column, . . B_1.

Or, if W = working pressure, p = pitch, S = surface, and T = thickness of steel plate, and if A_1—B_1—C_1—D_1—E_1—$F_1 G_1$—r G_1—H_1 and I_1, are the letters at the heads of the different columns, indicating the columns where the surface applicable to the case must be looked for, then :—

(1) To find W—— when T = $\frac{9}{16}$ inch, S = 256, p = 16, and B_1 the distinguishing letter of column from which the surface or pitch must be selected.

> In the Table No. 91 for $\frac{9}{16}$ inch steel plates in column B_1 the surface 256 is found, and opposite the surface is 75 lbs., which is the working pressure required to be found.

(2) To find S or p—— when T = $\frac{9}{16}$ inch, W = 75 lbs., and B_1 the distinguishing letter of column, in which the surface or pitch must be looked for.

> In the Table No. 91 for $\frac{9}{16}$ inch steel plates, opposite 75 lbs. in column B_1, 256 and 16 are found, which are the surface and pitch required.

(3) To find T—— when W = 75 lbs., S = 256, p = 16, and B_1 the distinguishing letter of column in which the surface must be selected :—

> The surface and pitch are large, but as the pressure is only moderately high and there are riveted washers, the steel plates need not be thick, and on looking down the Table No. 91 for $\frac{9}{16}$ inch steel plates, opposite 75 lbs. in column B_1 are found 256 and 16, therefore T = $\frac{9}{16}$ inch, which is the thickness of steel plate required to be found.

If in any of the foregoing examples the pitches only, or the surfaces only had been under consideration instead of both pitches and surfaces, the method of ascertaining either would have been exactly the same; as the pitches and surfaces are in each case given opposite the pressure under the distinguishing letter applicable to the case.

The pitches are given in inches and decimal parts of an inch, the latter can, if required, be easily converted into vulgar fractions, and when this is done, if the decimal part is not found equal to, say, $\frac{1}{16}$th part of an inch, it is advisable in practice to make the pitch to the sixteenth below, and such a small difference will be on the side of safety. If, for example, the pitch in the Table be 10·77 inches, it may in practice be 10¾ inches, if vulgar fractions be preferred to decimals.

As it is desirable that flat surfaces should be supported by stays forming squares, the following tables have been prepared for surfaces *with stays pitched* in squares or nearly so. When, however, there is a *considerable* difference in the pitches, it is thought prudent that the

pressure should *not* be so great; therefore, when the surface to be supported is obtained by the product of two pitches which are *considerably* different, the pressure which may be used will *not* be that opposite the surface, but may be easily found.

For example :—

If the pitches are as 4 to 3, the pressure opposite the surface or product of the two pitches may be reduced about 4 per cent.; when as 3 to 2, about 8 per cent.; when as 5 to 3 about 12 per cent.; and when as 2 to 1, the reduction of pressure may be about 20 per cent

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{1}{4}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	17·84	318·5	16·94	287·2	16·00	256·0
15	18·42	339·3	17·84	318·5	14·64	214·3	13·91	193·5	13·14	172·6
20	16·00	256·0	15·50	240·3	12·73	162·2	12·10	146·6	11·44	131·0
25	14·35	206·0	13·91	193·5	11·44	131·0	10·88	118·5	10·29	106·0
30	13·14	172·6	12·73	162·2	10·49	110·1	9·98	99·7	9·45	89·3
35	12·20	148·8	11·83	139·9	9·76	95·2	9·29	86·3	8·80	77·4
40	11·44	131·0	11·09	123·1	9·17	84·1	8·73	76·3	8·27	68·5
45	10·82	117·1	10·49	110·1	8·68	75·4	8·27	68·5	7·84	61·5
50	10·29	106·0	9·98	99·7	8·27	68·5	7·89	62·2	7·48	56·0
55	9·84	96·9	9·55	91·2	7·92	62·8	7·55	57·1	7·17	51·4
60	9·45	89·3	9·17	84·1	7·62	58·0	7·27	52·8	6·90	47·6
65	9·10	82·9	...	...	7·35	54·0	7·02	49·2	6·66	44·4
70	...	...	...	...	7·11	50·6	6·79	46·1	6·45	41·7
75	...	...	...	...	6·90	47·6	6·59	43·5	6·27	39·3
80	...	...	...	...	6·71	45·0	6·41	41·1	6·09	37·1
85	...	...	...	...	6·54	42·7	6·25	39·0	5·88	34·5
90	...	...	...	...	6·38	40·7	6·09	37·1	5·69	32·3
95	...	...	...	...	6·23	38·8	5·90	34·8	5·52	30·4
100	...	...	...	...	6·09	37·1	5·73	32·8	5·36	28·7
105	...	...	...	...	5·92	35·0	5·57	31·0	5·22	27·3
110	...	...	...	...	5·76	33·2	5·43	29·5	5·10	26·0
115	...	...	...	...	5·62	31·5	5·30	28·1	4·98	24·8
120	...	...	...	...	5·48	30·1	5·18	26·8	4·88	23·8
125	...	...	...	...	5·36	28·7	5·07	25·7	4·78	22·8
130	...	...	...	...	5·25	27·6	4·97	24·7	4·69	22·0
135	...	...	...	...	5·15	26·5	4·88	23·8	4·61	21·2
140	...	...	...	...	5·05	25·5	4·79	22·9	4·53	20·5
145	...	...	...	...	4·96	24·6	4·71	22·2	4·46	19·9
150	...	...	...	...	4·88	23·8	4·63	21·5	4·39	19·3
155	...	...	...	...	4·80	23·0	4·56	20·8	4·33	18·7
160	...	...	...	...	4·72	22·3	4·50	20·2	4·27	18·2
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.
Pressures, Pitches, and Surfaces.
Steel Plate $\frac{1}{4}$ inch thick.

TABLE No. 81
continued.

*F_1G_1		*H_1		*r G_1		*I_1	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
19·52	381·0	18·53	343·5	18·33	336·0	14·28	204·0
13·91	193·5	13·22	174·7	13·07	171·0	10·24	105·0
11·44	131·0	10·88	118·5	10·77	116·0	8·48	72·0
9·98	99·7	9·50	90·3	9·40	88·5	7·45	55·5
9·00	81·0	8·57	73·5	8·48	72·0	6·75	45·6
8·27	68·5	7·89	62·2	7·81	61·0	6·24	39·0
7·71	59·5	7·36	54·2	7·29	53·1	5·75	33·0
7·27	52·8	6·94	48·1	6·87	47·2	5·33	28·4
6·90	47·6	6·59	43·5	6·53	42·6	5·01	25·1
6·59	43·5	6·30	39·7	6·24	39·0	4·76	22·6
6·33	40·0	6·03	36·3	5·95	35·4	4·55	20·7
6·09	37·1	5·73	32·8	5·65	32·0	4·37	19·1
5·81	33·8	5·47	30·0	5·41	29·2	4·22	17·8
5·57	31·0	5·26	27·6	5·20	27·0	4·10	16·8
5·36	28·7	5·07	25·7	5·01	25·1	3·98	15·8
5·18	26·8	4·91	24·1	4·85	23·5	3·85	14·8
5·02	25·2	4·76	22·7	4·71	22·2	3·73	13·9
4·88	23·8	4·63	21·5	4·58	21·0	3·63	13·2
4·75	22·5	4·52	20·4	4·47	20·0	3·53	12·5
4·63	21·5	4·41	19·5	4·37	19·1	...	...
4·53	20·5	4·32	18·7	4·28	18·3	...	...
4·43	19·7	4·24	17·9	4·20	17·6	...	...
4·35	18·9	4·16	17·3	4·12	17·0	...	...
4·27	18·2	4·09	16·7	4·05	16·4	...	...
4·20	17·6	4·02	16·2	3·98	15·8	...	...
4·13	17·0	3·94	15·5	3·90	15·2	...	...
4·07	16·5	3·87	15·0	3·83	14·6	...	...
4·01	16·0	3·80	14·4	3·76	14·1	...	...
3·94	15·5	3·73	13·9	3·69	13·6	...	...
3·87	15·0	3·67	13·5	3·63	13·2	...	...
3·81	14·5	3·61	13·0	3 57	12·7	...	...
3·75	14·0	3·55	12·6	3·51	12·3	...	...
*F_1G_1		*H_1		*r G_1		*I_1	

e distinguishing letter in each column refers to the conditions h the pitches and surfaces are applicable; these conditions, ieir distinguishing letters, will be found immediately pre- *these Tables.*

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{9}{32}$ inch thick.

Pressure per sq. in.	*A₁		*B₁		*C₁		*D₁		*E₁	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	19·60	384·1	18·61	346·3	17·56	308·5
15	20·23	409·3	19·60	384·1	16·06	258·0	15·26	232·8	14·41	207·6
20	17·56	308·5	17·01	289·5	13·96	195·0	13·27	176·1	12·54	157·2
25	15·74	248·0	15·26	232·8	12·54	157·2	11·92	142·1	11·27	127·0
30	14·41	207·6	13·96	195·0	11·49	132·0	10·92	119·4	10·33	106·8
35	13·37	178·8	12·96	168·0	10·67	114·0	10·16	103·2	9·61	92·4
40	12·54	157·2	12·15	147·7	10·02	100·5	9·54	91·0	9·03	81·6
45	11·85	140·4	11·49	132·0	9·48	90·0	9·03	81·6	8·55	73·2
50	11·27	127·0	10·92	119·4	9·03	81·6	8·60	74·0	8·15	66·5
55	10·77	116·0	10·44	109·1	8·64	74·7	8·23	67·8	7·81	61·0
60	10·33	106·8	10·02	100·5	8·30	69·0	7·92	62·7	7·51	56·4
65	9·95	99·0	9·65	93·2	8·01	64·1	7·64	58·3	7·24	52·5
70	9·61	92·4	9·32	87·0	7·74	60·0	7·39	54·6	7·01	49·2
75	9·31	86·6	9·03	81·6	7·51	56·4	7·16	51·3	6·80	46·[illegible]
80	9·03	81·6	...	...	7·29	53·2	6·96	48·5	6·62	43[illegible]
85	...	...	...	...	7·10	50·4	6·78	46·0	6·44	41[illegible]
90	...	...	...	...	6·93	48·0	6·62	43·8	6·29	3[illegible]
95	...	...	...	...	6·76	45·8	6·46	41·8	6·15	[illegible]
100	...	...	...	...	6·62	43·8	6·32	40·0	5·98	[illegible]
105	...	...	...	...	6·48	42·0	6·19	38·4	5·81	[illegible]
110	...	...	...	...	6·35	40·3	6·06	36·7	5·65	[illegible]
115	...	...	...	...	6·23	38·8	5·90	34·8	5·51	[illegible]
120	...	...	...	...	6·12	37·5	5·75	33·1	5·39	[illegible]
125	...	...	...	...	5·98	35·7	5·62	31·6	5·27	[illegible]
130	...	...	...	...	5·84	34·1	5·50	30·2	5·16	[illegible]
135	...	...	...	...	5·71	32·6	5·39	29·0	5·06	[illegible]
140	...	...	...	...	5·60	31·3	5·28	27·9	4·97	[illegible]
145	...	...	...	...	5·49	30·1	5·18	26·9	4·88	2[illegible]
150	...	...	...	...	5·39	29·0	5·09	25·9	4·80	2[illegible]
155	...	...	...	...	5·29	28·0	5·01	25·1	4·72	22[illegible]
160	...	...	...	...	5·20	27·1	4·93	24·3	4·65	21
	*A₁		*B₁		*C₁		*D₁		*E₁	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding *these Tables.*

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{9}{32}$ inch thick.

Pressure per sq. in.	$^*F_1G_1$		$^*H_1$		$^*r\,G_1$		$^*I_1$	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	20·35	414·3	20·13	405·3	15·67	245·5
10	15·26	232·8	14·49	210·1	14·34	205·6	11·21	125·7
15	12·54	157·2	11·92	142·1	11·79	139·0	9·26	85·8
20	10·92	119·4	10·39	108·0	10·28	105·8	8·11	65·8
5	9·83	96·7	9·36	87·6	9·26	85·8	7·34	53·9
0	9·03	81·6	8·60	74·0	8·51	72·5	6·77	45·9
	8·41	70·8	8·02	64·3	7·94	63·0	6·34	40·2
	7·92	62·7	7·55	57·0	7·47	55·9	5·94	35·3
	7·51	56·4	7·16	51·3	7·09	50·3	5·55	30·8
	7·16	51·3	6·84	46·8	6·77	45·9	5·24	27·5
	6·87	47·2	6·56	43·1	6·50	42·3	4·99	24·9
	6·62	43·8	6·32	40·0	6·26	39·2	4·78	22·8
	6·39	40·9	6·11	37·3	6·03	36·4	4·58	21·0
	6·19	38·4	5·85	34·2	5·77	33·3	4·44	19·7
	5·98	35·7	5·62	31·6	5·55	30·8	4·31	18·6
	5·75	33·1	5·42	29·4	5·36	28·7	4·19	17·6
	5·56	30·9	5·25	27·5	5·19	26·9	4·09	16·7
	5·39	29·0	5·09	25·9	5·03	25·3	4·00	16·0
	5·23	27·4	4·95	24·5	4·90	24·0	3·89	15·1
	5·09	25·9	4·83	23·3	4·78	22·8	3·79	14·3
	4·97	24·7	4·71	22·2	4·66	21·7	3·70	13·6
	4·85	23·5	4·61	21·3	4·56	20·8	3·61	13·0
	4·75	22·5	4·52	20·4	4·47	20·0	3·53	12·5
	4·65	21·6	4·43	19·6	4·39	19·2	...	...
	4·56	20·8	4·35	18·9	4·31	18·6	...	...
	4·48	20·1	4·28	18·3	4·24	17·9	...	...
	4·41	19·4	4·21	17·7	4·17	17·4	...	...
	4·34	18·8	4·15	17·2	4·11	16·9	...	...
	4·27	18·2	4·09	16·7	4·05	16·4	...	...
	4·21	17·7	4·03	16·3	4·00	16·0	...	...
	4·15	17·2	3·97	15·8	3·93	15·4	...	...
	4·10	16·8	3·91	15·3	3·87	14·9	...	...
	$^*F_1G_1$		$^*H_1$		$^*r\,G_1$		$^*I_1$	

* The distinguishing letter in each column refers to the conditions which the pitches and surfaces are applicable; these conditions, th their distinguishing letters, will be found immediately pre- *ling these Tables.*

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{11}{32}$ inch thick.

Pressure per sq. in.	*A_1 Pitch	*A_1 Surface	*B_1 Pitch	*B_1 Surface	*C_1 Pitch	*C_1 Surface	*D_1 Pitch	*D_1 Surface	E^*_1 Pitch	E^*_1 Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	20·70	428·
15	...	...	...	...	18·92	358·0	17·96	322·8	16·96	287·
20	20·70	428·5	20·05	402·0	16·43	270·0	15·61	243·6	14·74	217·
25	18·54	344·0	17·96	322·8	14·74	217·2	14·00	196·0	13·22	175·
30	16·96	287·6	16·43	270·0	13·49	182·0	12·82	164·4	12·11	146·
35	15·73	247·4	15·24	232·3	12·52	156·8	11·90	141·8	11·25	126·
40	14·74	217·2	14·28	204·0	11·74	138·0	11·17	124·8	10·56	111·
45	13·92	193·7	13·49	182·0	11·10	123·3	10·56	111·6	9·99	99·
50	13·22	175·0	12·82	164·4	10·56	111·6	10·05	101·0	9·51	90·
55	12·63	159·6	12·24	150·0	10·10	102·0	9·61	92·4	9·10	82·
60	12·11	146·8	11·74	138·0	9·69	94·0	9·23	85·2	8·74	76·4
65	11·66	136·0	11·30	127·8	9·34	87·2	8·89	79·1	8·42	71·0
70	11·25	126·7	10·91	119·1	9·02	81·4	8·59	73·9	8·14	66·3
75	10·89	118·6	10·56	111·6	8·74	76·4	8·33	69·3	7·89	62·3
80	10·56	111·6	10·24	105·0	8·48	72·0	8·08	65·4	7·66	58·8
85	10·26	105·4	9·96	99·1	8·25	68·1	7·86	61·9	7·46	55·7
90	9·99	99·8	9·69	94·0	8·04	64·6	7·66	58·8	7·27	52·9
95	9·74	94·9	9·45	89·3	7·84	61·5	7·48	56·0	7·10	50·4
100	9·51	90·5	9·23	85·2	7·66	58·8	7·31	53·5	6·94	48·2
105	9·30	86·4	9·02	81·4	7·50	56·2	7·16	51·2	6·80	46·2
110	9·10	82·8	...	...	7·35	54·0	7·01	49·2	6·66	44·4
115	...	...	...	...	7·20	51·9	6·88	47·3	6·53	42·7
120	...	...	...	...	7·07	50·0	6·75	45·6	6·42	41·2
125	...	...	...	...	6·94	48·2	6·63	44·0	6·30	39·8
130	...	...	...	...	6·82	46·6	6·52	42·5	6·20	38·5
135	...	...	...	...	6·71	45·1	6·42	41·2	6·10	37·2
140	...	...	...	...	6·61	43·7	6·32	39·9	5·97	35·6
145	...	...	...	...	6·51	42·4	6·22	38·7	5·85	34·2
150	...	...	...	...	6·42	41·2	6·13	37·6	5·73	32·9
155	...	...	...	...	6·33	40·0	6·02	36·3	5·63	31·6
160	...	...	...	...	6·24	39·0	5·91	34·9	5·53	30·5
	*A_1		*B_1		*C_1		*D_1		E^*_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Steel Plate [illegible] inch thick.

Table No. [illegible] continued.

*F_1G_1		*H_1		*$r\,G_1$		*I_1	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	[illegible]	[illegible]
17·95	[illegible]	[illegible]	291·1	16·57	284·8	[illegible]	178·8
14·74	217·2	[illegible]	198·6	13·55	181·9	10·84	[illegible]
12·62	164·4	12·10	142·5	12·06	145·4	9·46	89·6
11·52	132·7	10·95	120·0	10·84	117·5	8·54	72·9
10·56	111·6	10·05	101·0	9·94	98·9	7·86	61·7
9·82	96·5	9·35	87·4	9·25	85·6	7·33	53·6
9·23	85·2	8·79	77·2	8·70	75·7	6·91	47·8
8·74	76·4	8·33	69·4	8·24	67·9	6·57	43·1
8·33	69·3	7·94	63·0	7·86	61·7	6·28	39·4
7·97	63·6	7·60	57·8	7·53	56·7	6·00	36·0
7·66	58·8	7·31	53·5	7·24	52·4	5·76	33·2
7·40	54·7	7·06	49·8	6·99	48·9	5·45	29·7
7·16	51·2	6·83	46·7	6·77	45·8	5·23	27·4
6·94	48·2	6·63	44·0	6·57	43·1	5·05	25·5
6·75	45·6	6·45	41·6	6·39	40·8	4·88	23·9
6·57	43·2	6·28	39·5	6·23	38·8	4·74	22·5
6·42	41·2	6·13	37·6	6·06	36·7	4·61	21·3
6·27	39·3	5·95	35·4	5·87	34·5	4·50	20·2
6·14	37·6	5·77	33·3	5·70	32·5	4·40	19·3
5·97	35·6	5·61	31·5	5·54	30·7	4·30	18·5
5·81	33·7	5·47	29·9	5·40	29·2	4·22	17·8
5·66	32·0	5·34	28·5	5·27	27·8	4·14	17·2
5·53	30·5	5·22	27·2	5·16	26·6	4·07	16·6
5·40	29·2	5·11	26·1	5·05	25·5	4·01	16·0
5·29	28·0	5·01	25·0	4·95	24·5	3·93	15·4
5·18	26·9	4·91	24·1	4·86	23·6	3·85	14·8
5·09	25·9	4·82	23·2	4·77	22·7	3·78	14·3
5·00	25·0	4·74	22·5	4·69	22·0	3·72	13·8
4·91	24·1	4·66	21·7	4·61	21·3	3·65	13·3
4·83	23·3	4·59	21·1	4·54	20·6	3·59	12·9
4·76	22·6	4·53	20·5	4·48	20·0	3·54	12·5
*F_1G_1		*H_1		*$r\,G_1$		*I_1	

The distinguishing letter in each column refers to the conditions hich the pitches and surfaces are applicable; these conditions, their distinguishing letters, will be found immediately pre-ng these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{3}{8}$ inch thick.

Pressure per sq. in.	$^*A_1$		$^*B_1$		$^*C_1$		$^*D_1$		$^*E_1$	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	20·35	414·3	19·32	373·5	18·24	332·6
20	...	...	...	...	17·67	312·2	16·78	281·6	15·84	251·0
25	19·95	398·0	19·32	373·5	15·84	251·0	15·05	226·5	14·21	202·0
30	18·24	332·6	17·67	312·2	14·49	210·1	13·77	189·7	13·01	169·3
35	16·91	286·0	16·38	268·5	13·45	181·0	12·78	163·5	12·08	146·0
40	15·84	251·0	15·35	235·6	12·61	159·1	11·99	143·8	11·33	128·5
45	14·96	223·7	14·49	210·1	11·92	142·1	11·33	128·5	10·71	114·8
50	14·21	202·0	13·77	189·7	11·33	128·5	10·78	116·2	10·19	104·0
55	13·57	184·1	13·15	173·0	10·83	117·3	10·30	106·2	9·75	95·0
60	13·01	169·3	12·61	159·1	10·39	108·0	9·89	97·8	9·36	87·6
65	12·52	156·7	12·13	147·3	10·01	100·2	9·53	90·8	9·02	81·3
70	12·08	146·0	11·71	137·2	9·67	93·5	9·20	84·7	8·71	76·0
75	11·69	136·6	11·33	128·5	9·36	87·6	8·91	79·5	8·44	71·3
80	11·33	128·5	10·99	120·8	9·08	82·5	8·65	74·9	8·20	67·2
85	11·01	121·2	10·68	114·0	8·83	78·0	8·41	70·8	7·97	63·6
90	10·71	114·8	10·39	108·0	8·60	74·0	8·20	67·2	7·77	60·4
95	10·44	109·1	10·13	102·7	8·39	70·4	8·00	64·0	7·58	57·5
100	10·19	104·0	9·89	97·8	8·20	67·2	7·81	61·1	7·41	55·0
105	9·96	99·3	9·67	93·5	8·02	64·3	7·64	58·5	7·25	52·6
110	9·75	95·0	9·46	89·5	7·85	61·6	7·49	56·1	7·11	50·5
115	9·55	91·2	9·26	85·8	7·69	59·2	7·34	53·9	6·97	48·6
120	9·36	87·6	9·08	82·5	7·55	57·0	7·20	51·9	6·84	46·8
125	9·18	84·4	...	...	7·41	55·0	7·07	50·1	6·72	45·2
130	9·02	81·3	...	...	7·28	53·1	6·95	48·4	6·61	43·6
135	...	...	...	...	7·16	51·3	6·84	46·8	6·50	42·2
140	...	...	...	...	7·05	49·7	6·73	45·3	6·40	41·0
145	...	...	...	...	6·94	48·2	6·63	44·0	6·30	39·7
150	...	...	...	...	6·84	46·8	6·53	42·7	6·21	38·6
155	...	...	...	...	6·74	45·5	6·44	41·5	6·13	37·6
160	...	...	...	...	6·65	44·2	6·36	40·4	6·02	36·2
	$^*A_1$		$^*B_1$		$^*C_1$		$^*D_1$		$^*E_1$	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, *with their* distinguishing letters, will be found immediately preceding *these* Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{3}{8}$ inch thick.

Pressure per sq. in.	*F_1G_1		*H_1		*r G_1		*T_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	19·32	373·5	18·35	336·7	18·15	329·4	14·14	200·0
15	15·84	251·0	15·05	226·5	14·88	221·6	11·63	135·3
20	13·77	189·7	13·09	171·3	12·95	167·7	10·15	103·0
25	12·37	153·0	11·76	138·3	11·63	135·3	9·14	83·6
30	11·33	128·5	10·78	116·2	10·66	113·8	8·40	70·6
35	10·53	111·0	10·02	100·5	9·92	98·4	7·83	61·4
40	9·89	97·8	9·41	88·6	9·32	86·8	7·38	54·5
45	9·36	87·6	8·91	79·5	8·82	77·8	7·00	49·0
50	8·91	79·5	8·49	72·1	8·40	70·6	6·69	44·8
55	8·53	72·8	8·12	66·1	8·05	64·8	6·42	41·2
60	8·20	67·2	7·81	61·1	7·74	59·9	6·19	38·3
65	7·90	62·5	7·54	56·8	7·46	55·7	5·93	35·1
70	7·64	58·5	7·29	53·2	7·22	52·1	5·68	32·3
75	7·41	55·0	7·07	50·1	7·00	49·0	5·46	29·9
80	7·20	51·9	6·88	47·3	6·81	46·4	5·28	27·9
85	7·01	49·2	6·70	44·9	6·63	44·0	5·11	26·1
90	6·84	46·8	6·53	42·7	6·47	41·9	4·96	24·6
95	6·68	44·6	6·38	40·8	6·32	40·0	4·83	23·3
100	6·53	42·7	6·25	39·0	6·19	38·3	4·71	22·2
105	6·40	41·0	6·12	37·5	6·04	36·5	4·60	21·2
110	6·27	39·4	5·96	35·5	5·88	34·5	4·50	20·3
115	6·16	37·9	5·80	33·7	5·73	32·9	4·41	19·5
120	6·02	36·2	5·66	32·0	5·59	31·2	4·33	18·8
125	5·88	34·5	5·53	30·6	5·46	29·9	4·26	18·1
130	5·74	33·0	5·41	29·3	5·35	28·5	4·19	17·5
135	5·62	31·6	5·30	28·1	5·24	27·5	4·13	17·0
140	5·51	30·3	5·20	27·1	5·14	26·4	4·06	16·5
145	5·40	29·2	5·11	26·1	5·05	25·5	4·01	16·1
150	5·30	28·1	5·02	25·2	4·96	24·6	3·94	15·5
155	5·21	27·2	4·94	24·3	4·88	23·8	3·87	15·0
160	5·13	26·3	4·86	23·6	4·80	23·1	3·81	14·5
	*F_1G_1		*H_1		*r G_1		*T_1	

* The distinguishing letter in each column refers to the conditions which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{13}{32}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	20·68	427·8	19·52	381·0
20	...	...	...	...	18·91	357·5	17·95	322·4	16·94	287·2
25	...	...	20·68	427·8	16·94	287·2	16·09	259·1	15·19	231·0
30	19·52	381·0	18·91	357·5	15·50	240·3	14·72	216·9	13·91	193·5
35	18·09	327·4	17·53	307·3	14·38	206·8	13·66	186·8	12·91	166·7
40	16·94	287·2	16·42	269·6	13·48	181·7	12·81	164·2	12·10	146·6
45	16·00	256·0	15·50	240·3	12·73	162·2	12·10	146·6	11·44	131·0
50	15·19	231·0	14·72	216·9	12·10	146·6	11·51	132·5	10·88	118·5
55	14·51	210·5	14·06	197·7	11·56	133·8	11·00	121·0	10·40	108·2
60	13·91	193·5	13·48	181·7	11·09	123·1	10·55	111·4	9·98	99·7
65	13·38	179·0	12·97	168·2	10·68	114·1	10·16	103·3	9·62	92·5
70	12·91	166·7	12·51	156·6	10·31	106·4	9·81	96·4	9·29	86·3
75	12·49	156·0	12·10	146·6	9·98	99·7	9·50	90·3	9·00	81·0
80	12·10	146·6	11·74	137·8	9·69	93·8	9·22	85·1	8·73	76·3
85	11·76	138·3	11·40	130·0	9·42	88·7	8·97	80·4	8·49	72·1
90	11·44	131·0	11·09	123·1	9·17	84·1	8·73	76·3	8·27	68·5
95	11·15	124·4	10·81	117·0	8·94	80·0	8·52	72·6	8·07	65·2
100	10·88	118·5	10·55	111·4	8·73	76·3	8·32	69·2	7·89	62·2
105	10·63	113·1	10·31	106·4	8·54	72·9	8·14	66·2	7·71	59·5
110	10·40	108·2	10·09	101·8	8·36	69·9	7·97	63·5	7·55	57·1
115	10·19	103·8	9·88	97·7	8·19	67·1	7·81	61·0	7·41	54·9
120	9·98	99·7	9·69	93·8	8·03	64·5	7·66	58·7	7·27	52·8
125	9·79	96·0	9·50	90·3	7·89	62·2	7·52	56·6	7·14	51·[illegible]
130	9·62	92·5	9·33	87·1	7·75	60·0	7·39	54·6	7·02	49·[illegible]
135	9·45	89·3	9·17	84·1	7·62	58·0	7·27	52·8	6·90	47·[illegible]
140	9·29	86·3	9·01	81·3	7·49	56·2	7·15	51·2	6·79	46·[illegible]
145	9·14	83·5	...	...	7·38	54·4	7·04	49·6	6·69	44·[illegible]
150	9·00	81·0	...	...	7·27	52·8	6·94	48·1	6·59	43·[illegible]
155	...	...	...	...	7·16	51·3	6·84	46·8	6·50	42·[illegible]
160	...	...	...	...	7·06	49·9	6·75	45·5	6·41	41·[illegible]
	*A_1		*B_1		*C_1		*D_1		E^*_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

TABLE No. 86 *continued.*

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{13}{32}$ inch thick.

per sq. in.	$*F_1G_1$		$*H_1$		$*r\ G_1$		$*I_1$	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
bs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	20·68	427·8	19·63	385·6	19·42	377·2	15·12	228·7
15	16·94	287·2	16·09	259·1	15·92	253·5	12·43	154·5
20	14·72	216·9	13·99	195·8	13·84	191·6	10·83	117·3
25	13·22	174·7	12·56	157·8	12·43	154·5	9·75	95·1
30	12·10	146·6	11·51	132·5	11·39	129·7	8·95	80·2
35	11·24	126·5	10·70	114·4	10·58	112·0	8·34	69·6
40	10·55	111·4	10·04	100·9	9·94	98·8	7·85	61·6
45	9·98	99·7	9·50	90·3	9·40	88·5	7·45	55·5
50	9·50	90·3	9·05	81·9	8·95	80·2	7·11	50·5
55	9·09	82·7	8·66	75·0	8·57	73·5	6·82	46·5
60	8·73	76·3	8·32	69·2	8·23	67·8	6·56	43·1
65	8·42	70·9	8·02	64·4	7·94	63·1	6·34	40·2
70	8·14	66·2	7·76	60·2	7·68	59·0	6·15	37·8
75	7·89	62·2	7·52	56·6	7·45	55·5	5·91	34·9
80	7·66	58·7	7·31	53·4	7·24	52·4	5·69	32·4
85	7·45	55·6	7·11	50·6	7·04	49·6	5·50	30·3
90	7·27	52·8	6·94	48·1	6·87	47·2	5·33	28·4
95	7·10	50·4	6·78	45·9	6·71	45·0	5·18	26·8
00	6·94	48·1	6·63	43·9	6·56	43·1	5·04	25·4
05	6·79	46·1	6·49	42·1	6·43	41·3	4·92	24·2
10	6·66	44·3	6·36	40·5	6·30	39·7	4·81	23·1
15	6·53	42·6	6·24	39·0	6·18	38·2	4·71	22·1
20	6·41	41·1	6·13	37·6	6·06	36·7	4·61	21·3
25	6·30	39·7	5·99	35·9	5·91	34·9	4·53	20·5
30	6·20	38·4	5·85	34·3	5·78	33·4	4·45	19·7
35	6·09	37·1	5·73	32·8	5·65	32·0	4·37	19·1
40	5·96	35·5	5·61	31·5	5·54	30·7	4·30	18·5
45	5·84	34·1	5·50	30·3	5·43	29·5	4·24	17·9
50	5·73	32·8	5·40	29·1	5·33	28·4	4·18	17·4
55	5·62	31·6	5·30	28·1	5·24	27·4	4·12	17·0
60	5·52	30·5	5·21	27·2	5·15	26·5	4·07	16·5
	$*F_1G_1$		$*H_1$		$*r\ G_1$		$*I_1$	

* The distinguishing letter in each column refers to the conditions
which the pitches and surfaces are applicable; these conditions,
ith their distinguishing letters, will be found immediately pre-
ding *these Tables.*

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{15}{32}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	20·30	412·4	19·16	357·2
25	...	...	...	...	19·16	367·2	18·19	331·1	17·17	295·0
30	...	...	...	...	17·52	307·0	16·64	276·9	15·71	246·8
35	20·46	418·8	19·82	393·0	16·25	264·0	15·43	238·2	14·57	212·4
40	19·16	367·2	18·56	344·6	15·22	231·7	14·46	209·2	13·66	186·6
45	18·08	327·1	17·52	307·0	14·37	206·6	13·66	186·6	12·90	166·5
50	17·17	295·0	16·64	276·9	13·66	186·6	12·98	168·5	12·26	150·5
55	16·39	268·7	15·88	252·3	13·04	170·2	12·40	153·7	11·72	137·3
60	15·71	246·8	15·22	231·7	12·51	156·5	11·89	141·4	11·24	126·4
65	15·11	228·3	14·64	214·4	12·04	144·9	11·44	131·0	10·82	117·1
70	14·57	212·4	14·12	199·5	11·62	135·0	11·05	122·1	10·45	109·2
75	14·09	198·6	13·66	186·6	11·24	126·4	10·69	114·3	10·11	102·3
80	13·66	186·6	13·24	175·3	10·90	118·8	10·37	107·6	9·81	96·3
85	13·26	176·0	12·86	165·3	10·59	112·2	10·08	101·6	9·54	91·0
90	12·90	166·5	12·51	156·5	10·31	106·3	9·81	96·3	9·28	86·2
95	12·57	158·1	12·19	148·5	10·05	101·0	9·56	91·5	9·05	82·0
100	12·26	150·5	11·89	141·4	9·84	96·9	9·34	87·2	8·84	78·2
105	11·98	143·6	11·62	135·0	9·59	92·0	9·13	83·4	8·65	74·8
110	11·72	137·3	11·36	129·1	9·38	88·1	8·93	79·8	8·46	71·6
115	11·47	131·6	11·12	123·7	9·19	84·5	8·75	76·6	8·29	68·8
120	11·24	126·4	10·90	118·8	9·01	81·2	8·58	73·7	8·13	66·2
125	11·02	121·6	10·69	114·3	8·84	78·2	8·42	71·0	7·98	63·8
130	10·82	117·1	10·49	110·2	8·68	75·4	8·27	68·5	7·84	61·5
135	10·63	113·0	10·31	106·3	8·53	72·8	8·13	66·2	7·71	59·5
140	10·45	109·2	10·13	102·6	8·39	70·5	8·00	64·0	7·59	57·6
145	10·27	105·6	9·97	99·4	8·26	68·2	7·87	62·0	7·47	55·8
150	10·11	102·3	9·81	96·3	8·13	66·2	7·75	60·1	7·36	54·1
155	9·96	99·2	9·66	93·3	8·01	64·2	7·64	58·4	7·25	52·6
160	9·81	96·3	9·52	90·6	7·90	62·4	7·53	56·8	7·15	51·1
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{15}{32}$ inch thick.

Pressure per sq. in.	*F_1G_1		*H_1		*r G_1		*I_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	17·09	292·1
15	19·16	367·2	18·19	331·1	17·99	323·9	14·02	196·7
20	16·64	276·9	15·80	249·8	15·63	244·4	12·20	149·0
25	14·92	222·7	14·18	201·0	14·02	196·7	10·97	120·4
30	13·66	186·6	12·98	168·5	12·84	164·9	10·06	101·3
35	12·68	160·8	12·05	145·3	11·92	142·2	9·36	87·7
40	11·89	141·4	11·31	127·9	11·19	125·2	8·80	77·5
45	11·24	126·4	10·69	114·3	10·58	111·9	8·34	69·5
50	10·69	114·3	10·17	103·5	10·06	101·3	7·95	63·2
55	10·22	104·5	9·73	94·6	9·62	92·7	7·61	58·0
60	9·81	96·3	9·34	87·2	9·24	85·4	7·32	53·6
65	9·45	89·3	9·00	81·0	8·90	79·3	7·07	50·0
70	9·13	83·4	8·69	75·6	8·61	74·1	6·84	46·8
75	8·84	78·2	8·42	71·0	8·34	69·5	6·64	44·1
80	8·58	73·7	8·18	66·9	8·10	65·6	6·46	41·7
85	8·35	69·7	7·96	63·3	7·88	62·1	6·29	39·6
90	8·13	66·2	7·75	60·1	7·68	58·9	6·14	37·7
95	7·94	63·0	7·57	57·3	7·49	56·1	5·96	35·5
00	7·75	60·1	7·40	54·7	7·32	53·6	5·78	33·4
05	7·59	57·6	7·24	52·4	7·17	51·4	5·62	31·6
10	7·43	55·2	7·09	50·3	7·02	49·3	5·48	30·0
15	7·28	53·1	6·95	48·4	6·89	47·4	5·35	28·6
20	7·15	51·1	6·83	46·6	6·76	45·7	5·23	27·3
25	7·02	49·3	6·71	45·0	6·64	44·1	5·12	26·2
30	6·90	47·6	6·59	43·5	6·53	42·6	5·01	25·1
35	6·79	46·1	6·49	42·1	6·42	41·3	4·92	24·2
40	6·68	44·7	6·39	40·8	6·33	40·0	4·82	23·3
45	6·58	43·3	6·29	39·6	6·23	38·8	4·75	22·5
50	6·49	42·1	6·20	38·5	6·14	37·7	4·67	21·8
55	6·40	40·9	6·12	37·4	6·04	36·4	4·60	21·1
60	6·31	39·8	6·00	36·0	5·92	35·1	4·58	20·0
	*F_1G_1		*H_1		*r G_1		*I_1	

* The distinguishing letter in each column refers to the conditions which the pitches and surfaces are applicable; these conditions, ith their distinguishing letters, will be found [illegible] *ding these Tables.*

Pressures, Pitches, and Surfaces.

Steel Plate ½ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	20·27	411·0
25	...	...	...	...	20·27	411·0	19·24	370·5	18·16	330·0
30	...	...	...	...	18·53	343·5	17·60	309·7	16·61	276·0
35	...	...	20·97	439·9	17·18	295·2	16·32	266·3	15·40	237·4
40	20·27	411·0	19·63	385·6	16·09	259·1	15·29	233·8	14·44	208·5
45	19·13	366·0	18·53	343·5	15·19	231·0	14·44	208·5	13·63	186·0
50	18·16	330·0	17·60	309·7	14·44	208·5	13·72	188·2	12·96	168·0
55	17·33	300·5	16·79	282·1	13·78	190·0	13·10	171·6	12·38	153·2
60	16·61	276·0	16·09	259·1	13·22	174·7	12·56	157·8	11·87	141·0
65	15·97	255·2	15·48	239·6	12·71	161·7	12·09	146·1	11·42	130·6
70	15·40	237·4	14·93	222·9	12·27	150·6	11·67	136·1	11·03	121·7
75	14·90	222·0	14·44	208·5	11·87	141·0	11·29	127·5	10·67	114·0
80	14·44	208·5	13·99	195·8	11·51	132·5	10·95	119·9	10·35	107·2
85	14·02	196·5	13·59	184·6	11·18	125·1	10·64	113·2	10·06	101·2
90	13·63	186·0	13·22	174·7	10·88	118·5	10·35	107·2	9·79	96·0
95	13·28	176·5	12·87	165·8	10·61	112·5	10·09	101·9	9·55	91·2
100	12·96	168·0	12·56	157·8	10·35	107·2	9·85	97·1	9·32	87·0
105	12·66	160·2	12·27	150·6	10·12	102·4	9·63	92·7	9·11	83·1
110	12·38	153·2	12·00	144·0	9·90	98·0	9·42	88·8	8·92	79·6
115	12·11	146·8	11·75	138·0	9·69	94·0	9·23	85·2	8·74	76·4
120	11·87	141·0	11·51	132·5	9·50	90·3	9·05	81·9	8·57	73·5
125	11·64	135·6	11·29	127·5	9·32	87·0	8·88	78·9	8·41	70·7
130	11·42	130·6	11·08	122·8	9·15	83·8	8·72	76·0	8·26	68·3
135	11·22	126·0	10·88	118·5	9·00	81·0	8·57	73·5	8·12	66·0
140	11·03	121·7	10·70	114·4	8·85	78·3	8·43	71·0	7·99	63·8
145	10·85	117·7	10·52	110·7	8·70	75·8	8·29	68·8	7·86	61·8
150	10·67	114·0	10·35	107·2	8·57	73·5	8·17	66·7	7·74	60·0
155	10·51	110·5	10·19	103·9	8·44	71·3	8·05	64·7	7·63	58·2
160	10·35	107·2	10·04	100·9	8·32	69·2	7·93	62·9	7·52	56·6
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Steel Plate ½ inch thick.

Pressure per sq. in.	$^*F_1G_1$		$^*H_1$		$^*rG_1$		$^*I_1$	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	18·07	326·7
15	20·27	411·0	19·24	370·5	19·03	362·4	14·82	219·8
20	17·60	309·7	16·71	279·3	16·53	273·3	12·89	166·3
25	15·78	249·0	14·99	224·7	14·82	219·8	11·58	134·3
30	14·44	208·5	13·72	188·2	13·57	184·2	10·62	112·9
35	13·40	179·5	12·73	162·2	12·60	158·7	9·88	97·6
40	12·56	157·8	11·94	142·6	11·81	139·6	9·28	86·1
45	11·87	141·0	11·29	127·5	11·17	124·8	8·79	77·2
50	11·29	127·5	10·74	115·3	10·62	112·9	8·37	70·1
55	10·79	116·4	10·26	105·4	10·15	103·2	8·02	64·3
60	10·35	107·2	9·85	97·1	9·75	95·1	7·71	59·4
65	9·97	99·4	9·49	90·1	9·39	88·2	7·44	55·3
70	9·63	92·7	9·17	84·1	9·07	82·3	7·19	51·8
75	9·32	87·0	8·88	78·9	8·79	77·2	6·98	48·7
80	9·05	81·9	8·62	74·3	8·53	72·8	6·79	46·0
85	8·80	77·4	8·38	70·3	8·30	68·8	6·61	43·7
90	8·57	73·5	8·17	66·7	8·08	65·4	6·45	41·6
95	8·36	69·9	7·97	63·5	7·89	62·2	6·30	39·7
100	8·17	66·7	7·79	60·6	7·71	59·4	6·17	38·0
105	7·99	63·8	7·62	58·0	7·54	56·9	6·01	36·1
110	7·82	61·2	7·46	55·7	7·39	54·6	5·85	34·2
115	7·67	58·8	7·31	53·5	7·24	52·4	5·70	32·5
120	7·52	56·6	7·18	51·5	7·11	50·5	5·56	31·0
125	7·39	54·6	7·05	49·7	6·98	48·7	5·44	29·6
130	7·26	52·7	6·93	48·0	6·86	47·1	5·32	28·3
135	7·14	51·0	6·82	46·5	6·75	45·6	5·22	27·2
140	7·02	49·3	6·71	45·0	6·64	44·1	5·12	26·2
145	6·92	47·8	6·61	43·7	6·54	42·8	5·03	25·3
150	6·82	46·5	6·51	42·4	6·45	41·6	4·94	24·4
155	6·72	45·1	6·42	41·2	6·36	40·4	4·86	23·6
160	6·63	43·9	6·33	40·1	6·27	39·4	4·78	22·9
	$^*F_1G_1$		$^*H_1$		$^*rG_1$		$^*I_1$	

* The distinguishing letter in each column refers to the conditions which the pitches and surfaces are applicable; these conditions, ith their distinguishing letters, will be found immediately preding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{17}{32}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitc
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	20·30	412·1	19·
30	...	...	...	...	19·54	382·0	18·56	344·4	17·
35	...	...	...	...	18·12	328·3	17·20	296·0	16·
40	...	...	20·71	429·0	16·97	288·0	16·12	259·8	15·
45	20·17	407·1	19·54	382·0	16·02	256·6	15·22	231·6	14·
50	19·15	367·0	18·56	344·4	15·22	231·6	14·45	209·0	13·
55	18·28	334·1	17·71	313·6	14·53	211·1	13·80	190·6	13·
60	17·51	306·8	16·97	288·0	13·93	194·0	13·23	175·2	12·
65	16·84	283·6	16·32	266·3	13·40	179·5	12·73	162·2	12·
70	16·24	263·8	15·74	247·7	12·93	167·1	12·29	151·0	11·
75	15·70	246·6	15·22	231·6	12·50	156·4	11·89	141·3	11·
80	15·22	231·6	14·74	217·5	12·12	147·0	11·52	132·9	10·
85	14·77	218·3	14·32	205·0	11·77	138·7	11·20	125·4	10·
90	14·37	206·5	13·93	194·0	11·46	131·3	10·90	118·8	10·
95	14·00	196·0	13·57	184·1	11·17	124·7	10·62	112·8	10·
100	13·65	186·5	13·23	175·2	10·90	118·8	10·37	107·5	9·
105	13·33	177·9	12·93	167·1	10·65	113·4	10·13	102·6	9·
110	13·04	170·0	12·64	159·8	10·42	108·5	9·91	98·3	9·
115	12·76	162·9	12·37	153·1	10·20	104·0	9·71	94·2	9·
120	12·50	156·4	12·12	147·0	10·06	100·0	9·51	90·6	9·
125	12·26	150·4	11·89	141·3	9·81	96·2	9·34	87·2	8·
130	12·03	144·8	11·67	136·1	9·63	92·7	9·17	84·1	8·
135	11·82	139·7	11·46	131·3	9·46	89·5	9·01	81·2	8·
140	11·61	134·9	11·26	126·8	9·30	86·5	8·86	78·5	8·
145	11·42	130·4	11·07	122·7	9·15	83·8	8·72	76·0	8·
150	11·24	126·3	10·90	118·8	9·01	81·2	8·58	73·6	8·
155	11·06	122·4	10·73	115·1	8·87	78·7	8·45	71·5	8·
160	10·90	118·8	10·57	111·7	8·74	76·5	8·33	69·4	7·
	*A_1		*B_1		*C_1		*D_1		

* The distinguishing letter in each column refers to the co to which the pitches and surfaces are applicable; these con with their distinguishing letters, will be found immediat *ceding these* Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{17}{32}$ inch thick.

Pressure per sq. in.	*F_1G_1 Pitch	*F_1G_1 Surface	*H_1 Pitch	*H_1 Surface	*[illegible] Pitch	*[illegible] Surface	*[illegible] Pitch	*[illegible] Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	..	..		
10	...	...	...	...	..	..	[illegible]	[illegible]
15	...	...	20·30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	18·56	344·4	17·62	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	16·63	276·7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	15·22	231·6	14·45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35	14·12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40	13·23	175·2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45	12·50	156·4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50	11·89	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
55	11·36	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60	10·90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
65	10·49	110·1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
70	10·13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75	9·81	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
80	9·51	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
85	9·25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
95	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
105	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
110	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
115	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
120	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
125	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
130	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
135	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
140	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
145	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
150	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
155	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
160	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
	*F [illegible]		[illegible]		[illegible]		[illegible]	

* The distinguishing [illegible] to which the pitches and [illegible] with their distinguishing [illegible] ceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{9}{16}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surfa
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. in
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	20·15	406·
30	...	...	...	...	20·55	422·6	19·52	381·0	18·42	339·
35	...	...	...	...	19·05	363·1	18·09	327·4	17·08	291·
40	...	...	...	...	17·84	318·5	16·94	287·2	16·00	256·
45	...	...	20·55	422·6	16·84	283·7	16·00	256·0	15·10	228·
50	20·15	406·0	19·52	381·0	16·00	256·0	15·19	231·0	14·35	206·
55	19·22	369·6	18·62	346·9	15·27	233·2	14·51	210·5	13·70	187·
60	18·42	339·3	17·84	318·5	14·64	214·3	13·91	193·5	13·14	172·
65	17·71	313·6	17·16	294·4	14·08	198·3	13·38	179·0	12·64	159·
70	17·08	291·7	16·54	273·8	13·58	184·5	12·91	166·7	12·20	148·
75	16·51	272·6	16·00	256·0	13·14	172·6	12·49	156·0	11·80	139·
80	16·00	256·0	15·50	240·3	12·73	162·2	12·10	146·6	11·44	131·
85	15·53	241·2	15·05	226·5	12·37	153·0	11·76	138·3	11·12	123·
90	15·10	228·2	14·64	214·3	12·03	144·8	11·44	131·0	10·82	117·1
95	14·71	216·5	14·26	203·3	11·73	137·5	11·15	124·4	10·54	111·
100	14·35	206·0	13·91	193·5	11·44	131·0	10·88	118·5	10·29	106·0
105	14·01	196·4	13·58	184·5	11·18	125·0	10·63	113·1	10·06	101·
110	13·70	187·8	13·28	176·4	10·93	119·6	10·40	108·2	9·84	96·9
115	13·41	179·9	13·00	169·0	10·71	114·6	10·19	103·8	9·64	92·9
120	13·14	172·6	12·73	162·2	10·49	110·1	9·98	99·7	9·45	89·3
125	12·88	166·0	12·49	156·0	10·29	106·0	9·79	96·0	9·27	86·0
130	12·64	159·8	12·25	150·2	10·10	102·1	9·62	92·5	9·10	82·9
135	12·41	154·1	12·03	144·8	9·93	98·5	9·45	89·3	8·94	80·0
140	12·20	148·8	11·83	139·9	9·76	95·2	9·29	86·3	8·80	77·
145	11·99	143·9	11·63	135·3	9·60	92·2	9·14	83·5	8·65	74·9
150	11·80	139·3	11·44	131·0	9·45	89·3	9·00	81·0	8·52	72·6
155	11·62	135·0	11·26	126·9	9·30	86·6	8·86	78·5	8·39	70·5
160	11·44	131·0	11·09	123·1	9·17	84·1	8·73	76·3	8·27	68·5
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately *preceding these* Tables.

FLAT SURFACES.

TABLE No. 91 *continued.*

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{9}{16}$ inch thick.

Pressure per sq. in.	$*F_1G_1$		$*H_1$		$*r\,G_1$		$*I_1$	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	..	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	16·43	270·0
20	19·52	381·0	18·53	343·5	18·33	336·0	14·28	204·0
25	17·49	306·0	16·61	276·0	16·43	270·0	12·82	164·4
30	16·00	256·0	15·19	231·0	15·03	226·0	11·74	138·0
35	14·84	220·2	14·10	198·8	13·94	194·5	10·91	119·1
40	13·91	193·5	13·22	174·7	13·07	171·0	10·24	105·0
45	13·14	172·6	12·49	156·0	12·35	152·6	9·69	94·0
50	12·49	156·0	11·87	141·0	11·74	138·0	9·23	85·2
55	11·93	142·3	11·34	128·7	11·22	126·0	8·83	78·0
60	11·44	131·0	10·88	118·5	10·77	116·0	8·48	72·0
65	11·01	121·3	10·48	109·8	10·37	107·5	8·18	66·9
70	10·63	113·1	10·12	102·4	10·01	100·2	7·91	62·5
75	10·29	106·0	9·79	96·0	9·69	94·0	7·66	58·8
80	9·98	99·7	9·50	90·3	9·40	88·5	7·45	55·5
85	9·70	94·2	9·24	85·4	9·14	83·6	7·25	52·5
90	9·45	89·3	9·00	81·0	8·90	79·3	7·07	50·0
95	9·21	84·9	8·77	77·0	8·68	75·4	6·90	47·6
100	9·00	81·0	8·57	73·5	8·48	72·0	6·75	45·6
105	8·80	77·4	8·38	70·2	8·29	68·8	6·61	43·7
110	8·61	74·1	8·20	67·3	8·12	66·0	6·48	42·0
115	8·44	71·2	8·04	64·6	7·96	63·3	6·35	40·4
120	8·27	68·5	7·89	62·2	7·81	61·0	6·24	39·0
125	8·12	66·0	7·74	60·0	7·66	58·8	6·13	37·6
130	7·98	63·6	7·61	57·9	7·53	56·7	6·00	36·0
135	7·84	61·5	7·48	56·0	7·40	54·8	5·87	34·4
140	7·71	59·5	7·36	54·2	7·29	53·1	5·75	33·0
145	7·59	57·7	7·25	52·5	7·17	51·5	5·63	31·7
150	7·48	56·0	7·14	51·0	7·07	50·0	5·55	30·8
155	7·37	54·3	7·04	49·5	6·97	48·5	5·43	29·4
160	7·27	52·8	6·94	48·1	6·87	47·2	5·33	28·4
	$*F_1G_1$		$*H_1$		$*r\,G_1$		$*I_1$	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding *these Tables.*

Pressures, Pitches, and Surfaces.

Steel Plate ⅝ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	20·23
35	...	...	...	...	20·93	438·1	19·87	394·9	18·75
40	...	...	...	...	19·60	384·1	18·61	346·3	17·56
45	...	...	...	...	18·49	342·1	17·56	308·5	16·58
50	...	...	...	...	17·56	308·5	16·68	278·2	15·74
55	...	...	20·45	418·5	16·76	281·0	15·92	253·5	15·03
60	20·23	409·3	19·60	384·1	16·06	258·0	15·26	232·8	14·41
65	19·45	378·3	18·84	355·0	15·45	238·6	14·67	215·4	13·86
70	18·75	351·7	18·16	330·1	14·90	222·0	14·15	200·4	13·37
75	18·13	328·6	17·56	308·5	14·41	207·6	13·69	187·5	12·93
80	17·56	308·5	17·01	289·5	13·96	195·0	13·27	176·1	12·54
85	17·05	290·7	16·52	272·9	13·56	183·9	12·89	166·1	12·18
90	16·58	274·8	16·06	258·0	13·19	174·0	12·54	157·2	11·85
95	16·14	260·7	15·64	244·8	12·85	165·2	12·21	149·2	11·54
100	15·74	248·0	15·26	232·8	12·54	157·2	11·92	142·1	11·27
105	15·37	236·4	14·90	222·0	12·25	150·0	11·64	135·6	11·01
110	15·03	226·0	14·56	212·2	11·98	143·5	11·39	129·7	10·77
115	14·71	216·4	14·25	203·2	11·72	137·5	11·15	124·3	10·54
120	14·41	207·6	13·96	195·0	11·49	132·0	10·92	119·4	10·33
125	14·12	199·6	13·69	187·5	11·27	127·0	10·72	114·9	10·14
130	13·86	192·1	13·43	180·5	11·06	122·3	10·52	110·7	9·95
135	13·61	185·2	13·19	174·0	10·86	118·0	10·33	106·8	9·78
140	13·37	178·8	12·96	168·0	10·67	114·0	10·16	103·2	9·61
145	13·15	172·8	12·74	162·4	10·50	110·3	9·99	99·8	9·45
150	12·93	167·3	12·54	157·2	10·33	106·8	9·83	96·7	9·31
155	12·73	162·1	12·34	152·3	10·17	103·5	9·68	93·8	9·16
160	12·54	157·2	12·15	147·7	10·02	100·5	9·54	91·0	9·03
	*A_1		*B_1		*C_1		*D_1		*E_1

* The distinguishing letter in each column refers to the condit to which the pitches and surfaces are applicable; these conditi with their distinguishing letters, will be found immediately *ceding these Tables.*

FLAT SURFACES.

TABLE No. 93 *continued.*

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{5}{8}$ inch thick.

per sq. in.	*F_1G_1		*H_1		*r G_1		*I_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
s.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	—	—	...	...	...	...
0	...	...	—	—	...	...	...	...
5	...	...	...	—	...	...	18·04	325·4
20	...	...	20·35	414·3	20·13	405·2	15·67	245·5
25	19·21	369·0	18·24	332·7	18·04	325·4	14·06	197·6
30	17·56	308·5	16·63	276·2	16·49	272·2	12·87	165·7
35	16·28	265·2	15·47	239·3	15·30	234·1	11·95	142·9
40	15·26	232·8	14·49	210·1	14·34	205·6	11·21	125·7
45	14·41	207·6	13·69	187·5	13·54	183·4	10·60	112·4
50	13·69	187·5	13·01	169·2	12·87	165·7	10·09	101·8
55	13·07	171·0	12·43	154·5	12·29	151·2	9·65	93·1
60	12·54	157·2	11·92	142·1	11·79	139·1	9·26	85·8
65	12·06	145·6	11·47	131·6	11·35	128·8	8·92	79·7
70	11·64	135·6	11·07	122·6	10·95	120·0	8·62	74·4
75	11·27	127·0	10·72	114·9	10·60	112·4	8·36	69·8
80	10·92	119·4	10·39	108·0	10·28	105·8	8·11	65·8
85	10·62	112·7	10·10	102·0	9·99	99·9	7·89	62·2
90	10·33	106·8	9·83	96·7	9·73	94·7	7·69	59·2
95	10·07	101·5	9·59	91·9	9·49	90·0	7·51	56·4
100	9·83	96·7	9·36	87·6	9·26	85·8	7·34	53·9
105	9·61	92·4	9·15	83·7	9·05	82·0	7·18	51·6
110	9·40	88·5	8·95	80·2	8·86	78·5	7·04	49·5
115	9·21	84·9	8·77	77·0	8·68	75·4	6·90	47·6
120	9·03	81·6	8·60	74·0	8·51	72·5	6·77	45·9
125	8·86	78·6	8·44	71·2	8·36	69·8	6·65	44·3
130	8·70	75·8	8·29	68·8	8·21	67·4	6·54	42·8
135	8·55	73·2	8·15	66·5	8·07	65·1	6·44	41·4
140	8·41	70·8	8·02	64·3	7·94	63·0	6·34	40·2
145	8·28	68·5	7·89	62·3	7·81	61·0	6·24	38·9
150	8·15	66·5	7·77	60·4	7·69	59·2	6·16	37·9
155	8·03	64·5	7·66	58·6	7·58	57·5	6·06	36·6
160	7·92	62·7	7·55	57·0	7·47	55·9	5·94	35·3
	*F_1G_1		*H_1		*r G_1		*I_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{21}{32}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	20·76	431·0	19·59
40	...	...	...	...	20·47	419·2	19·44	377·9	18·34
45	...	...	...	...	19·32	373·3	18·34	336·6	17·31
50	...	...	...	...	18·34	336·6	17·42	303·5	16·44
55	...	...	...	...	17·51	306·5	16·62	276·5	15·69
60	...	...	20·47	419·2	16·77	281·5	15·93	253·9	15·04
65	20·32	412·9	19·68	387·4	16·13	260·3	15·32	234·8	14·47
70	19·59	383·8	18·98	360·2	15·56	242·1	14·78	218·5	13·96
75	18·93	358·6	18·34	336·6	15·04	226·4	14·29	204·3	13·50
80	18·34	336·6	17·77	315·9	14·58	212·6	13·85	191·9	13·08
85	17·81	317·1	17·25	297·7	14·16	200·4	13·45	181·0	12·71
90	17·31	299·8	16·77	281·5	13·77	189·6	13·08	171·3	12·36
95	16·86	284·4	16·34	267·0	13·41	180·0	12·75	162·6	12·05
100	16·44	270·5	15·93	253·9	13·08	171·3	12·44	154·7	11·75
105	16·06	257·9	15·56	242·1	12·78	163·4	12·15	147·6	11·48
110	15·69	246·4	15·21	231·4	12·50	156·2	11·88	141·2	11·23
115	15·36	236·0	14·88	221·6	12·23	149·7	11·63	135·3	11·00
120	15·04	226·4	14·58	212·6	11·99	143·7	11·40	129·9	10·78
125	14·75	217·6	14·29	204·3	11·75	138·2	11·18	125·0	10·57
130	14·47	209·4	14·02	196·7	11·54	133·1	10·97	120·4	10·38
135	14·21	201·9	13·77	189·6	11·33	128·4	10·78	116·2	10·19
140	13·96	194·9	13·53	183·1	11·14	124·0	10·59	112·2	10·02
145	13·72	188·4	13·30	177·0	10·95	120·0	10·42	108·6	9·86
150	13·50	182·3	13·08	171·3	10·78	116·2	10·25	105·1	9·70
155	13·29	176·6	12·88	165·9	10·61	112·6	10·09	101·9	9·55
160	13·08	171·3	12·68	160·9	10·45	109·3	9·95	98·9	9·41
	*A_1		*B_1		*C_1		*D_1		*E

* The distinguishing letter in each column refers to the condit to which the pitches and surfaces are applicable; these conditi *with their* distinguishing letters, will be found immediately *ceding* these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{21}{32}$ inch thick.

	*F_1G_1		*H_1		*r G_1		*I_1	
	Pitch.	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	18·84	355·1
	...	...	...	...	...	...	16·36	267·8
5	20·06	402·7	19·05	363·0	18·84	355·1	14·68	215·4
0	18·34	336·6	17·42	303·5	17·23	296·9	13·43	180·5
5	17·01	289·3	16·15	261·0	15·98	255·3	12·47	155·6
0	15·93	253·9	15·13	229·1	14·97	224·2	11·70	136·9
5	15·04	226·4	14·29	204·3	14·14	199·9	11·06	122·3
0	14·29	204·3	13·58	184·5	13·43	180·5	10·52	110·7
5	13·65	186·3	12·97	168·3	12·83	164·7	10·06	101·2
0	13·08	171·3	12·44	154·7	12·30	151·4	9·65	93·2
5	12·59	158·5	11·97	143·3	11·84	140·2	9·30	86·5
0	12·15	147·6	11·55	133·5	11·43	130·6	8·99	80·8
75	11·75	138·2	11·18	125·0	11·06	122·3	8·70	75·8
80	11·40	129·9	10·84	117·5	10·72	115·1	8·45	71·4
85	11·07	122·6	10·53	111·0	10·42	108·6	8·22	67·6
90	10·78	116·2	10·25	105·1	10·14	102·9	8·01	64·1
95	10·50	110·4	9·99	99·9	9·89	97·8	7·81	61·1
00	10·25	105·1	9·76	95·2	9·65	93·2	7·64	58·3
05	10·02	100·4	9·54	91·0	9·44	89·1	7·47	55·8
10	9·80	96·1	9·33	87·1	9·23	85·3	7·32	53·6
15	9·60	92·2	9·14	83·6	9·05	81·9	7·18	51·5
20	9·41	88·6	8·96	80·3	8·87	78·7	7·04	49·6
25	9·23	85·3	8·79	77·4	8·70	75·8	6·92	47·8
30	9·07	82·2	8·64	74·6	8·55	73·1	6·80	46·2
35	8·91	79·4	8·49	72·1	8·40	70·6	6·69	44·7
40	8·76	76·8	8·35	69·7	8·26	68·3	6·58	43·4
45	8·62	74·4	8·22	67·5	8·13	66·1	6·49	42·1
150	8·49	72·1	8·09	65·5	8·01	64·1	6·39	40·9
155	8·36	69·9	7·97	63·5	7·89	62·3	6·30	39·7
160	8·24	67·9	7·86	61·7	7·78	60·5	6·22	38·7
	*F_1G_1		*H_1		*r G_1		*I_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately pre- *ceding these Tables.*

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{23}{32}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	..
40	...	...	...	...	...	...	...	...	19·91
45	...	...	...	...	20·97	440·0	19·91	396·6	18·79
50	...	...	...	...	19·91	396·6	18·91	357·5	17·84
55	...	...	...	...	19·00	361·0	18·04	325·6	17·03
60	...	...	...	...	18·20	331·5	17·29	298·9	16·32
65	...	...	...	...	17·50	306·4	16·62	276·4	15·69
70	...	...	20·60	424·5	16·88	285·0	16·03	257·1	15·14
75	20·55	422·6	19·91	396·6	16·32	266·4	15·50	240·3	14·64
80	19·91	396·6	19·29	372·2	15·81	250·1	15·02	225·7	14·18
85	19·33	373·6	18·72	350·6	15·35	235·7	14·58	212·8	13·77
90	18·79	353·2	18·20	331·5	14·93	223·0	14·18	201·3	13·40
95	18·30	334·9	17·73	314·3	14·54	211·5	13·82	191·0	13·05
100	17·84	318·5	17·29	298·9	14·18	201·3	13·48	181·7	12·73
105	17·42	303·6	16·88	285·0	13·85	192·0	13·16	173·4	12·44
110	17·03	290·0	16·50	272·3	13·54	183·5	12·87	165·8	12·16
115	16·66	277·7	16·14	260·7	13·26	175·8	12·60	158·8	11·91
120	16·32	266·4	15·81	250·1	12·99	168·7	12·34	152·4	11·67
125	16·00	256·0	15·50	240·3	12·73	162·2	12·10	146·6	11·44
130	15·69	246·3	15·21	231·3	12·50	156·2	11·88	141·2	11·23
135	15·41	237·4	14·93	223·0	12·27	150·6	11·67	136·2	11·03
140	15·14	229·2	14·67	215·2	12·06	145·5	11·47	131·5	10·84
145	14·88	221·5	14·42	208·0	11·86	140·6	11·28	127·2	10·66
150	14·64	214·3	14·18	201·3	11·67	136·2	11·09	123·1	10·49
155	14·40	207·6	13·96	195·0	11·49	132·0	10·92	119·4	10·33
160	14·18	201·3	13·75	189·1	11·31	128·0	10·76	115·8	10·18
	*A_1		*B_1		*C_1		*D_1		*E

* The distinguishing letter in each column refers to the condi to which the pitches and surfaces are applicable; these condit with their distinguishing letters, will be found immediately *ceding these Tables.*

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{23}{32}$ inch thick.

TABLE No. 96 *continued.*

*F_1G_1		*H_1		*r G_1		*I_1	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	20·45	418·5
...	...	...	...	...	...	17·75	315·3
...	...	20·68	427·8	20·45	418·5	15·92	253·5
19·91	396·6	18·91	357·5	18·70	349·7	14·56	212·2
18·46	340·8	17·53	307·3	17·34	300·6	13·52	182·7
17·29	298·9	16·42	269·6	16·24	263·8	12·67	160·6
16·32	266·4	15·50	240·3	15·33	235·1	11·98	143·5
15·50	240·3	14·72	216·9	14·56	212·2	11·39	129·7
14·80	219·0	14·06	197·7	13·91	193·5	10·88	118·5
14·18	201·3	13·48	181·7	13·33	177·8	10·44	109·1
13·64	186·2	12·97	168·2	12·83	164·6	10·06	101·1
13·16	173·4	12·51	156·6	12·38	153·3	9·71	94·3
12·73	162·2	12·10	146·6	11·98	143·5	9·40	88·5
12·34	152·4	11·74	137·8	11·61	134·9	9·13	83·3
11·99	143·8	11·40	130·0	11·28	127·3	8·87	78·7
11·67	136·2	11·09	123·1	10·98	120·5	8·64	74·7
11·37	129·3	10·81	117·0	10·70	114·5	8·43	71·1
11·09	123·1	10·55	111·4	10·44	109·1	8·23	67·8
10·84	117·6	10·31	106·4	10·20	104·2	8·05	64·9
10·60	112·5	10·09	101·8	9·98	99·7	7·89	62·2
10·38	107·9	9·88	97·7	9·78	95·6	7·73	59·8
10·18	103·6	9·69	93·8	9·58	91·9	7·58	57·5
9·98	99·7	9·50	90·3	9·40	88·5	7·45	55·5
9·80	96·1	9·33	87·1	9·23	85·3	7·32	53·5
9·63	92·8	9·17	84·1	9·07	82·3	7·20	51·8
9·47	89·7	9·01	81·3	8·92	79·6	7·08	50·1
9·31	86·8	8·87	78·7	8·78	77·1	6·97	48·6
9·17	84·1	8·73	76·3	8·64	74·7	6·87	47·2
9·03	81·6	8·60	74·0	8·51	72·5	6·77	45·9
8·90	79·2	8·48	71·9	8·39	70·4	6·68	44·6
*F_1G_1		*H_1		*r G_1		*I_1	

* The distinguishing letter in each column refers to the conditions which the pitche[illegible] surfaces are applicable; these conditions, th their di[illegible]etters, will be found immediately pre- ding th[illegible]

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{3}{4}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	..	...	...	...	...	...	...	20·70	428·5
45	...	...	...	...	...	...	20·70	428·5	19·53	381·5
50	...	...	...	...	20·70	428·5	19·65	386·2	18·54	344·0
55	...	...	...	...	19·75	390·0	18·75	351·6	17·70	313·2
60	...	...	...	...	18·92	358·0	17·96	322·8	16·96	287·6
65	...	...	...	...	18·19	331·0	17·27	298·5	16·31	266·0
70	...	...	...	...	17·54	307·7	16·66	277·6	15·73	247·4
75	...	...	20·70	428·5	16·96	287·6	16·10	259·5	15·21	231·3
80	20·70	428·5	20·05	402·0	16·43	270·0	15·61	243·6	14·74	217·2
85	20·09	403·6	19·46	378·7	15·95	254·5	15·15	229·6	14·31	204·8
90	19·53	381·5	18·92	358·0	15·51	240·7	14·74	217·2	13·92	193·7
95	19·02	361·7	18·42	339·5	15·11	228·3	14·35	206·1	13·56	183·8
100	18·54	344·0	17·96	322·8	14·74	217·2	14·00	196·0	13·22	175·0
105	18·10	327·9	17·54	307·7	14·39	207·1	13·67	187·0	12·92	166·9
110	17·70	313·2	17·14	294·0	14·07	198·0	13·37	178·8	12·63	159·6
115	17·31	299·9	16·78	281·5	13·77	189·6	13·09	171·3	12·36	152·9
120	16·96	287·6	16·43	270·0	13·49	182·0	12·82	164·4	12·11	146·8
125	16·62	276·4	16·11	259·5	13·22	175·0	12·57	158·1	11·88	141·2
130	16·31	266·0	15·80	249·7	12·98	168·5	12·33	152·2	11·66	136·0
135	16·01	256·3	15·51	240·7	12·74	162·4	12·11	146·8	11·45	131·1
140	15·73	247·4	15·24	232·3	12·52	156·8	11·90	141·8	11·25	126·7
145	15·46	239·1	14·98	224·5	12·31	151·6	11·71	137·1	11·07	122·5
150	15·21	231·3	14·74	217·2	12·11	146·8	11·52	132·7	10·89	118·6
155	14·97	224·0	14·50	210·4	11·92	142·2	11·34	128·6	10·72	115·0
160	14·74	217·2	14·28	204·0	11·74	138·0	11·17	124·8	10·56	111·6
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{3}{4}$ inch thick.

per sq. in.	$^*F_1G_1$		$^*H_1$		$^*r\,G_1$		$^*I_1$	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	..	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	18·45	340·6
25	...	...	...	...	...	...	16·54	273·6
30	20·70	428·5	19·65	386·2	19·43	377·8	15·13	229·0
35	19·18	368·1	18·21	331·9	18·02	324·6	14·04	197·2
40	17·96	322·8	17·06	291·1	16·87	284·8	13·16	173·3
45	16·96	287·6	16·10	259·5	15·93	253·8	12·43	154·7
50	16·11	259·5	15·30	234·1	15·13	229·0	11·82	139·8
55	15·37	236·4	14·60	213·4	14·45	208·8	11·30	127·6
60	14·74	217·2	14·00	196·0	13·85	191·9	10·84	117·5
65	14·17	201·0	13·47	181·5	13·32	177·6	10·43	108·9
70	13·67	187·0	12·99	168·9	12·85	165·3	10·08	101·6
75	13·22	175·0	12·57	158·1	12·43	154·7	9·75	95·2
80	12·82	164·4	12·19	148·5	12·06	145·4	9·46	89·6
85	12·45	155·1	11·84	140·2	11·71	137·2	9·20	84·7
90	12·11	146·8	11·52	132·7	11·39	129·9	8·96	80·3
95	11·80	139·4	11·22	126·0	11·11	123·4	8·74	76·4
100	11·52	132·7	10·95	120·0	10·84	117·5	8·54	72·9
105	11·25	126·7	10·70	114·6	10·59	112·2	8·35	69·7
110	11·01	121·2	10·47	109·7	10·36	107·4	8·17	66·8
115	10·78	116·2	10·25	105·1	10·14	102·9	8·01	64·1
120	10·56	111·6	10·05	101·0	9·94	98·9	7·86	61·7
125	10·36	107·4	9·86	97·2	9·75	95·2	7·71	59·5
130	10·17	103·5	9·68	93·7	9·58	91·8	7·58	57·4
135	9·99	99·8	9·51	90·5	9·41	88·6	7·45	55·5
140	9·82	96·5	9·35	87·4	9·25	85·6	7·33	53·8
145	9·66	93·4	9·20	84·6	9·10	82·9	7·22	52·1
150	9·51	90·5	9·05	82·0	8·96	80·3	7·11	50·6
155	9·36	87·7	8·92	79·5	8·83	77·9	7·01	49·1
160	9·23	85·2	8·79	77·2	8·70	75·7	6·91	47·8
	$^*F_1G_1$		$^*H_1$		$^*r\,G_1$		$^*I_1$	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{25}{32}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	20·27	411·0
50	...	...	...	...	...	...	20·39	416·0	19·24	370·5
55	...	...	...	...	20·49	420·2	19·46	378·7	18·36	337·3
60	...	...	...	...	19·63	385·6	18·64	347·7	17·60	309·7
65	...	...	...	...	18·88	356·4	17·92	321·4	16·92	286·3
70	...	...	...	...	18·20	331·4	17·28	298·9	16·32	266·3
75	...	...	...	...	17·60	309·7	16·71	279·3	15·78	249·0
80	...	...	20·81	433·1	17·05	290·7	16·19	262·2	15·29	233·8
85	20·85	434·8	20·20	408·0	16·55	274·0	15·72	247·2	14·84	220·4
90	20·27	411·0	19·63	385·6	16·09	259·1	15·29	233·8	14·44	208·5
95	19·74	389·6	19·12	365·7	15·67	245·8	14·89	221·8	14·06	197·8
100	19·24	370·5	18·64	347·7	15·29	233·8	14·52	211·0	13·72	188·2
105	18·79	353·1	18·20	331·4	14·93	222·9	14·18	201·2	13·40	179·5
110	18·36	337·3	17·79	316·6	14·59	213·1	13·87	192·3	13·10	171·6
115	17·97	322·9	17·41	303·1	14·28	204·0	13·57	184·2	12·82	164·4
120	17·60	309·7	17·05	290·7	13·99	195·8	13·29	176·8	12·56	157·8
125	17·25	297·6	16·71	279·3	13·72	188·2	13·04	170·0	12·32	151·8
130	16·92	286·3	16·39	268·8	13·46	181·2	12·79	163·7	12·09	146·1
135	16·61	276·0	16·09	259·1	13·22	174·7	12·56	157·8	11·87	141·0
140	16·32	266·3	15·81	250·0	12·99	168·7	12·34	152·4	11·67	136·1
145	16·04	257·3	15·54	241·6	12·77	163·1	12·14	147·4	11·47	131·6
150	15·78	249·0	15·29	233·8	12·56	157·8	11·94	142·6	11·29	127·5
155	15·53	241·1	15·04	226·4	12·36	152·9	11·76	138·2	11·11	123·5
160	15·29	233·8	14·81	219·5	12·18	148·3	11·58	134·1	10·95	119·9
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditi to which the pitches and surfaces are applicable; these conditi with their distinguishing letters, will be found immediatel *ceding* these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{24}{32}$ inch thick.

Lbs. per sq. in.	*F_1G_1		*H_1		*rG_1		*I_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
s.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	...	...
0	...	..	...	...	...	...	19·15	366·8
5	...	...	...	...	...	...	17·16	294·6
0	...	...	20·39	416·0	20·17	406·9	15·70	246·5
5	19·91	396·5	18·90	357·4	18·70	349·6	14·56	212·2
0	18·64	347·7	17·70	313·5	17·51	306·7	13·65	186·4
5	17·60	309·7	16·71	279·3	16·53	273·3	12·89	166·3
0	16·71	279·3	15·87	252·0	15·70	246·5	12·26	150·3
5	15·95	254·5	15·15	229·6	14·99	224·7	11·71	137·2
0	15·29	233·8	14·52	211·0	14·37	206·4	11·23	126·2
5	14·70	216·2	13·97	195·2	13·82	191·0	10·81	117·9
0	14·18	201·2	13·48	181·7	13·33	177·8	10·44	[illegible]
75	13·72	188·2	13·04	170·0	12·89	166·3	10·11	[illegible]
80	13·29	176·8	12·64	159·7	12·50	156·3	[illegible]	[illegible]
85	12·91	166·8	12·27	150·7	12·14	147·5	[illegible]	[illegible]
90	12·56	157·8	11·94	142·6	11·81	139·6	[illegible]	[illegible]
95	12·24	149·8	11·64	135·4	11·51	132·6	[illegible]	[illegible]
00	11·94	142·6	11·35	129·0	11·23	126·2	[illegible]	[illegible]
05	11·67	136·1	11·09	123·1	10·98	120·5	[illegible]	[illegible]
10	11·41	130·2	10·85	117·8	10·74	115·3	[illegible]	[illegible]
15	11·17	124·8	10·62	112·9	10·51	110·5	[illegible]	[illegible]
20	10·95	119·9	10·41	108·5	10·30	106·2	[illegible]	[illegible]
25	10·74	115·3	10·21	104·4	10·11	102·2	[illegible]	[illegible]
30	10·54	111·1	10·03	100·6	9·92	[illegible]	[illegible]	[illegible]
35	10·35	107·2	9·85	97·1	9·75	[illegible]	[illegible]	[illegible]
40	10·18	103·6	9·68	93·8	9·58	[illegible]	[illegible]	[illegible]
45	10·01	100·2	9·53	90·8	9·43	[illegible]	[illegible]	[illegible]
50	9·85	97·1	9·38	88·0	9·28	[illegible]	[illegible]	[illegible]
55	9·70	94·1	9·24	85·3	9·14	[illegible]	[illegible]	[illegible]
60	9·56	91·4	9·10	82·8	9·01	[illegible]	[illegible]	[illegible]
	*F_1G_1		*H_1		*rG_1		*I_1	

* The distinguishing letter in each column [illegible] to which the pitches and surfaces are applicable. [illegible] with their distinguishing letters, [illegible] preceding *these Tables.*

Pressures, Pitches, and Surfaces

Steel Plate $\frac{13}{16}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	19·95	398·0
55	...	...	...	...	...	...	20·17	406·9	19·03	362·3
60	...	...	...	...	20·35	414·3	19·32	373·5	18·24	332·6
65	...	...	...	...	19·56	382·9	18·58	345·2	17·53	307·5
70	...	...	...	...	18·86	356·0	17·91	321·0	16·91	286·0
75	...	...	...	...	18·24	332·6	17·32	300·0	16·35	267·3
80	...	...	...	...	17·67	312·2	16·78	281·6	15·84	251·0
85	...	...	20·93	438·3	17·15	294·2	16·29	265·4	15·38	236·5
90	...	...	20·35	414·3	16·68	278·2	15·84	251·0	14·96	223·7
95	20·46	418·6	19·82	392·8	16·24	263·8	15·43	238·1	14·57	212·3
100	19·95	398·0	19·32	373·5	15·84	251·0	15·05	226·5	14·21	202·0
105	19·47	379·3	18·86	356·0	15·47	239·3	14·69	216·0	13·88	192·6
110	19·03	362·3	18·44	340·0	15·12	228·7	14·36	206·4	13·57	184·1
115	18·62	346·8	18·04	325·5	14·80	219·0	14·06	197·7	13·28	176·4
120	18·24	332·6	17·67	312·2	14·49	210·1	13·77	189·7	13·01	169·3
125	17·87	319·6	17·32	300·0	14·21	202·0	13·50	182·4	12·76	162·8
130	17·53	307·5	16·99	288·6	13·94	194·4	13·25	175·6	12·52	156·7
135	17·21	296·3	16·68	278·2	13·69	187·4	13·01	169·3	12·29	151·1
140	16·91	286·0	16·38	268·5	13·45	181·0	12·78	163·5	12·08	146·0
145	16·62	276·3	16·10	259·4	13·22	174·9	12·57	158·0	11·88	141·1
150	16·35	267·3	15·84	251·0	13·01	169·3	12·37	153·0	11·69	136·6
155	16·09	258·9	15·59	243·0	12·80	164·0	12·17	148·2	11·50	132·4
160	15·84	251·0	15·35	235·6	12·61	159·1	11·99	143·8	11·33	128·5
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, *with their distinguishing letters, will be found immediately preceding these Tables.*

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{13}{16}$ inch thick.

TABLE No. 99
continued.

*F_1G_1		*H_1		*r G_1		*I_1	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	19·85	394·0
...	...	...	...	...	...	17·79	316·4
...	...	...	...	20·91	437·2	16·27	264·7
20·64	426·0	19·59	384·0	19·38	375·6	15·09	227·7
19·32	373·5	18·35	336·7	18·15	329·4	14·14	200·0
18·24	332·6	17·32	300·0	17·13	293·4	13·36	178·4
17·32	300·0	16·45	270·6	16·27	264·7	12·69	161·2
16·53	273·2	15·70	246·5	15·53	241·2	12·13	147·1
15·84	251·0	15·05	226·5	14·88	221·6	11·63	135·3
15·23	232·1	14·47	209·5	14·31	205·0	11·19	125·4
14·69	216·0	13·96	195·0	13·81	190·8	10·81	116·8
14·21	202·0	13·50	182·4	13·36	178·4	10·46	109·4
13·77	189·7	13·09	171·3	12·95	167·7	10·15	103·0
13·37	178·9	12·71	161·6	12·57	158·1	9·86	97·3
13·01	169·3	12·37	153·0	12·23	149·7	9·60	92·2
12·67	160·7	12·05	145·2	11·92	142·1	9·36	87·7
12·37	153·0	11·76	138·3	11·63	135·3	9·14	83·6
12·08	146·0	11·49	132·0	11·36	129·2	8·94	79·9
11·81	139·6	11·23	126·2	11·11	123·6	8·75	76·5
11·56	133·8	11·00	121·0	10·88	118·4	8·57	73·4
11·33	128·5	10·78	116·2	10·66	113·8	8·40	70·6
11·11	123·6	10·57	111·8	10·46	109·4	8·25	68·0
10·91	119·0	10·38	107·7	10·27	105·5	8·10	65·7
10·71	114·8	10·19	104·0	10·09	101·8	7·96	63·4
10·53	111·0	10·02	100·5	9·92	98·4	7·83	61·4
10·36	107·3	9·86	97·2	9·75	95·2	7·71	59·5
10·19	104·0	9·70	94·2	9·60	92·2	7·59	57·7
10·04	100·8	9·55	91·3	9·45	89·4	7·48	56·0
9·89	97·8	9·41	88·6	9·32	86·8	7·38	54·5
*F_1G_1		*H_1		*r G_1		*I_1	

The distinguishing letter in each column refers to the conditions which the pitches and surfaces are applicable; these conditions, h their distinguishing letters, will be found immediately pre-ing these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{27}{32}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	
10	...	...	...	...	...	...	...	...	...	
15	...	...	...	...	...	...	...	...	...	
20	...	...	...	...	...	...	...	...	...	
25	...	...	...	...	...	...	...	...	...	
30	...	...	...	...	...	...	...	...	...	
35	...	...	...	...	...	...	...	...	...	
40	...	...	...	...	...	...	...	...	...	
45	...	...	...	...	...	...	...	...	...	
50	...	...	...	...	...	...	...	...	20·65	[illegible]
55	...	...	...	...	...	...	...	...	19·70	[illegible]
60	...	...	...	...	...	...	20·00	400·0	18·87	[illegible]
65	...	...	...	...	20·25	410·3	19·23	369·8	18·15	[illegible]
70	...	...	...	...	19·53	381·4	18·54	343·9	17·50	[illegible]
75	...	...	...	...	18·88	356·4	17·92	321·3	16·92	[illegible]
80	...	...	...	...	18·29	334·5	17·36	301·6	16·39	[illegible]
85	...	...	...	...	17·75	315·1	16·86	284·2	15·91	[illegible]
90	...	...	...	...	17·26	298·0	16·39	268·8	15·48	[illegible]
95	...	...	20·51	420·9	16·81	282·6	15·96	254·9	15·07	[illegible]
100	20·65	426·5	20·00	400·0	16·39	268·8	15·57	242·5	14·70	[illegible]
105	20·16	406·4	19·53	381·4	16·01	256·2	15·20	231·2	14·36	[illegible]
110	19·70	388·2	19·08	364·3	15·65	244·9	14·86	221·0	14·04	[illegible]
115	19·27	371·6	18·67	348·7	15·31	234·5	14·55	211·6	13·74	[illegible]
120	18·87	356·4	18·29	334·5	15·00	225·0	14·25	203·1	13·46	[illegible]
125	18·50	342·4	17·92	321·3	14·70	216·2	13·97	195·2	13·19	[illegible]
130	18·15	329·4	17·58	309·2	14·42	208·1	13·71	187·9	12·95	[illegible]
135	17·81	317·4	17·26	298·0	14·16	200·6	13·46	181·2	12·71	[illegible]
140	17·50	306·3	16·95	287·5	13·91	193·7	13·22	174·9	12·49	[illegible]
145	17·20	296·0	16·67	277·8	13·68	187·2	13·00	169·0	12·28	[illegible]
150	16·92	286·3	16·39	268·8	13·46	181·2	12·79	163·6	12·09	[illegible]
155	16·65	277·2	16·13	260·3	13·25	175·5	12·59	158·6	11·90	[illegible]
160	16·39	268·8	15·88	252·3	13·04	170·2	12·40	153·8	11·72	[illegible]
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditi[illegible] to which the pitches and surfaces are applicable; these conditi[illegible] *with* their distinguishing letters, will be found immediately p[illegible] *ceding* these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{27}{32}$ inch thick.

per sq. in.	$^*F_1G_1$		$^*H_1$		$^*r\ G_1$		$^*I_1$	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
s.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	20·55	422·2
5	...	...	...	...	...	...	18·41	339·0
0	...	...	...	...	...	...	16·83	283·5
5	...	...	20·28	411·4	20·06	402·4	15·61	243·8
0	20·00	400·0	18·99	360·7	18·78	352·9	14·63	214·1
5	18·87	356·4	17·92	321·3	17·73	314·3	13·82	191·0
0	17·92	321·3	17·02	289·8	16·83	283·5	13·13	172·5
5	17·10	292·7	16·25	264·0	16·07	258·3	12·54	157·3
0	16·39	268·8	15·57	242·5	15·40	237·2	12·03	144·7
5	15·76	248·5	14·97	224·3	14·81	219·4	11·58	134·0
70	15·20	231·2	14·44	208·7	14·29	204·2	11·17	124·9
75	14·70	216·2	13·97	195·2	13·82	191·0	10·81	117·0
80	14·25	203·1	13·54	183·3	13·39	179·4	10·49	110·0
85	13·83	191·5	13·15	172·9	13·01	169·2	10·19	103·9
90	13·46	181·2	12·79	163·6	12·65	160·1	9·92	98·5
95	13·11	171·9	12·46	155·3	12·33	152·0	9·67	93·6
00	12·79	163·6	12·16	147·9	12·03	144·7	9·44	89·2
05	12·49	156·1	11·88	141·1	11·75	138·1	9·23	85·2
10	12·22	149·3	11·62	135·0	11·49	132·1	9·03	81·6
15	11·96	143·1	11·37	129·4	11·25	126·6	8·85	78·3
20	11·72	137·4	11·14	124·2	11·02	121·6	8·68	75·3
25	11·49	132·1	10·93	119·5	10·81	117·0	8·52	72·6
30	11·28	127·2	10·73	115·1	10·61	112·7	8·37	70·0
35	11·08	122·8	10·54	111·1	10·43	108·7	8·22	67·6
40	10·89	118·6	10·36	107·3	10·25	105·1	8·09	65·4
45	10·71	114·7	10·19	103·8	10·08	101 7	7·96	63·4
50	10·54	111·1	10·03	100·6	9·92	98·5	7·84	61·5
55	10·38	107·7	9 87	97·5	9·77	95·5	7·72	59·7
60	10·22	104·5	9·73	94·7	9·63	92·7	7·61	58·0
	$^*F_1G_1$		$^*H_1$		$^*r\ G_1$		$^*I_1$	

* The distinguishing letter in each column refers to the conditions o which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preeding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{7}{8}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.
5	...	...	...	...	...	...	...	..	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	20·37
60	...	...	...	...	...	...	20·68	427·8	19·52
65	...	...	...	...	20·94	438·6	19·88	395·4	18·76
70	...	...	...	...	20·19	407·7	19·17	367·6	18·09
75	...	...	...	...	19·52	381·0	18·53	343·5	17·49
80	...	...	...	...	18·91	357·5	17·95	322·4	16·94
85	...	...	...	...	18·35	336·8	17·43	303·7	16·45
90	...	...	...	...	17·84	318·5	16·94	287·2	16·00
95	...	...	...	...	17·38	302·0	16·50	272·4	15·58
100	...	...	20·68	427·8	16·94	287·2	16·09	259·1	15·19
105	20·84	434·5	20·19	407·7	16·54	273·8	15·71	247·0	14·84
110	20·37	415·0	19·73	389·5	16·17	261·6	15·36	236·1	14·51
115	19·93	397·3	19·31	372·8	15·83	250·5	15·03	226·1	14·20
120	19·52	381·0	18·91	357·5	15·50	240·3	14·72	216·9	13·91
125	19·13	366·0	18·53	343·5	15·19	231·0	14·44	208·5	13·63
130	18·76	352·1	18·18	330·5	14·91	222·3	14·16	200·7	13·38
135	18·42	339·3	17·84	318·5	14·64	214·3	13·91	193·5	13·14
140	18·09	327·4	17·53	307·3	14·38	206·8	13·66	186·8	12·91
145	17·78	316·3	17·23	296·9	14·14	199·9	13·43	180·5	12·69
150	17·49	306·0	16·94	287·2	13·91	193·5	13·22	174·7	12·49
155	17·21	296·3	16·67	278·1	13·69	187·4	13·01	169·3	12·29
160	16·94	287·2	16·42	269·6	13·48	181·7	12·81	164·2	12·10
	*A_1		*B_1		*C_1		*D_1		*E_1

* The distinguishing letter in each column refers to the conditi
to which the pitches and surfaces are applicable ; these conditio
with their distinguishing letters, will be found immediately p
ceding these Tables.

FLAT SURFACES.

TABLE No. 101 *continued.*

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{7}{8}$ inch thick.

per sq. in.	*F_1G_1		*H_1		*r G_1		*I_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
s.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	19·03	362·4
0	...	...	...	...	...	...	17·40	303·0
5	...	...	20·97	439·9	20·74	430·2	16·14	260·5
0	20·68	427·8	19·63	385·6	19·42	377·2	15·12	228·7
5	19·52	381·0	18·53	343·5	18·33	336·0	14·28	204·0
0	18·53	343·5	17·60	309·7	17·40	303·0	13·57	184·2
55	17·68	312·8	16·79	282·1	16·61	276·0	12·96	168·0
60	16·94	287·2	16·09	259·1	15·92	253·5	12·43	154·5
65	16·29	265·6	15·48	239·6	15·31	234·4	11·96	143·0
70	15·71	247·0	14·93	222·9	14·77	218·1	11·54	133·2
75	15·19	231·0	14·44	208·5	14·28	204·0	11·17	124·8
80	14·72	216·9	13·99	195·8	13·84	191·6	10·83	117·3
85	14·30	204·5	13·59	184·6	13·44	180·7	10·52	110·8
90	13·91	193·5	13·22	174·7	13·07	171·0	10·24	105·0
95	13·55	183·6	12·87	165·8	12·74	162·3	9·99	99·7
100	13·22	174·7	12·56	157·8	12·43	154·5	9·75	95·1
105	12·91	166·7	12·27	150·6	12·14	147·4	9·53	90·8
110	12·62	159·4	12·00	144·0	11·87	141·0	9·32	87·0
115	12·35	152·7	11·75	138·0	11·62	135·1	9·13	83·4
120	12·10	146·6	11·51	132·5	11·39	129·7	8·95	80·2
125	11·87	141·0	11·29	127·5	11·17	124·8	8·79	77·2
130	11·65	135·8	11·08	122·8	10·96	120·2	8·63	74·5
135	11·44	131·0	10·88	118·5	10·77	116·0	8·48	72·0
140	11·24	126·5	10·70	114·4	10·58	112·0	8·34	69·6
145	11·06	122·3	10·52	110·7	10·41	108·4	8·21	67·4
150	10·88	118·5	10·35	107·2	10·24	105·0	8·08	65·4
155	10·71	114·8	10·19	103·9	10·09	101·8	7·96	63·4
160	10·55	111·4	10·04	100·9	9·94	98·8	7·85	61·6
	*F_1G_1		*H_1		*r G_1		*I_1	

* The distinguishing letter in each column refers to the conditions o which the pitches and surfaces are applicable; these conditions, ith their distinguishing letters, will be found immediately preeding *these Tables.*

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{29}{32}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pit
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	20·
65	...	...	...	...	...	...	20·53	421·8	19·
70	...	...	...	...	20·85	435·0	19·80	392·1	18·
75	...	...	...	...	20·16	406·4	19·14	366·3	18·
80	...	...	...	...	19·53	381·3	18·54	343·8	17·
85	...	...	...	...	18·95	359·3	18·00	324·0	16·
90	...	...	...	...	18·43	339·6	17·50	306·3	16·
95	...	...	...	...	17·94	322·1	17·04	290·5	16·
100	...	...	...	...	17·50	306·3	16·62	276·2	15·
105	...	...	20·85	435·0	17·08	292·0	16·23	263·4	15·
110	...	...	20·38	415·5	16·70	279·0	15·86	251·7	14·
115	20·58	423·8	19·94	397·7	16·34	267·1	15·52	241·0	14·
120	20·16	406·4	19·53	381·3	16·00	256·0	15·20	231·2	14·
125	19·75	390·4	19·14	366·3	15·69	246·2	14·90	222·2	14·
130	19·38	375·6	18·77	352·5	15·39	237·0	14·62	213·9	13·
135	19·02	361·9	18·43	339·6	15·11	228·4	14·36	206·2	13·
140	18·68	349·2	18·10	327·7	14·85	220·5	14·10	199·0	13·
145	18·36	337·3	17·79	316·6	14·59	213·1	13·87	192·4	13·
150	18·06	326·3	17·50	306·3	14·36	206·2	13·64	186·1	12·
155	17·77	316·0	17·22	296·6	14·13	199·7	13·43	180·3	12·
160	17·50	306·3	16·95	287·5	13·91	193·6	13·22	174·9	12·
	*A_1		*B_1		*C_1		*D_1		

* The distinguishing letter in each column refers to the co
to which the pitches and surfaces are applicable; these co
with their distinguishing letters, will be found immediat
ceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate [illegible] inch thick.

*F_1G_1		*I_1		[illegible]		[illegible]	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	..	[illegible]					..
...	..	[illegible]	[illegible]				..
...	..	..					..
...	..	..					
...	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
...	..	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
...	..	[illegible]				[illegible]	[illegible]
...	..	20·23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20·14	406·4	19·14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19·14	366·3	18·17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18·26	333·5	17·34	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17·50	306·3	16·62	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16·92	283·2	15·98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16·23	263·4	15·41	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15·69	246·2	14·90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15·20	231·2	14·44	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14·78	217·9	14·02	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14·36	206·2	13·64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13·98	195·5	13·29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13·64	186·1	12·96	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13·32	177·4	12·66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13·03	169·9	13·38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12·75	162·6	12·12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12·49	156·1	11·88	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12·25	150·1	11·65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12·02	144·6	11·43	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11·81	139·4	11·23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11·60	134·7	11·03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11·41	130·2	10·85	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11·23	126·1	10·68	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11·05	122·2	10·51	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10·89	113·8	10·36	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*F_1G_1		*I_1		[illegible]		[illegible]	

The distinguishing letter in each [illegible] which the pitches and surfaces [illegible] h their distinguishing letters, [illegible] ing these *Tables*.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{15}{16}$ inch thick

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	20·80	432·6
65	...	...	...	...	...	...	...	...	19·99	399·8
70	...	...	...	...	...	...	20·43	417·4	19·28	371·7
75	...	...	...	...	20·80	432·6	19·74	390·0	18·63	347·3
80	...	...	...	...	20·15	406·0	19·13	366·0	18·05	326·0
85	...	...	...	...	19·55	382·4	18·57	344·8	17·52	307·1
90	...	...	...	...	19·01	361·5	18·05	326·0	17·04	290·4
95	...	...	...	...	18·51	342·8	17·58	309·1	16·59	275·4
100	...	...	...	...	18·05	326·0	17·14	294·0	16·18	262·0
105	...	...	...	...	17·62	310·7	16·74	280·2	15·80	249·8
110	...	...	...	...	17·23	296·9	16·36	267·8	15·45	238·7
115	...	...	20·57	423·3	16·86	284·2	16·01	256·4	15·12	228·6
120	20·80	432·6	20·15	406·0	16·51	272·6	15·68	246·0	14·81	219·3
125	20·38	415·6	19·74	390·0	16·18	262·0	15·37	236·4	14·51	210·8
130	19·99	399·8	19·37	375·2	15·88	252·1	15·08	227·5	14·24	202·9
135	19·62	385·2	19·01	361·5	15·59	243·0	14·81	219·3	13·98	195·6
140	19·28	371·7	18·67	348·8	15·31	234·5	14·55	211·7	13·74	188·8
145	18·95	359·1	18·35	337·0	15·05	226·6	14·30	204·6	13·51	182·5
150	18·63	347·3	18·05	326·0	14·81	219·3	14·07	198·0	13·29	176·[illegible]
155	18·34	336·3	17·76	315·6	14·57	212·4	13·85	191·8	13·08	171·[illegible]
160	18·05	326·0	17·49	306·0	14·35	206·0	13·63	186·0	12·88	166·[illegible]
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

[illegible]LAT SURFACES.

[illegible] [illegible] Pitches, and Surfaces.

[illegible] Plate [illegible] $\frac{1}{?}$ inch thick.

[illegible]		[illegible]		[illegible]		[illegible]	
[illegible]	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
[illegible]	[illegible]	in.	[illegible]	in.	[illegible]	[illegible]	[illegible]
		19·92	[illegible]88·0	20·[illegible]8	[illegible]	[illegible]	[illegible]
[illegible]0	[illegible]32·[illegible]	[illegible]3·74	[illegible]30·0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]1	[illegible]90·[illegible]	[illegible]3·75	[illegible]51·[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]4	[illegible]55·[illegible]	[illegible]7·[illegible]9	[illegible]20·[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]5	[illegible]28·[illegible]	[illegible]7·[illegible]4	[illegible]94·0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]8	[illegible]01·[illegible]	[illegible]6·48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]1	[illegible]80·2	[illegible]5·[illegible]0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]62·0	[illegible]5·[illegible]7	[illegible]36·[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]8	[illegible]46·0	[illegible]4·[illegible]0	[illegible]22·0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]31·[illegible]	[illegible]4·46	209·2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]1	[illegible]19·3	[illegible]4·[illegible]7	[illegible]98·0	[illegible]3·91	[illegible]	[illegible]	[illegible]
[illegible]2	[illegible]08·1	[illegible]3·70	[illegible]87·[illegible]	[illegible]3·[illegible]	[illegible]	[illegible]	[illegible]
[illegible]7	[illegible]98·0	[illegible]3·37	[illegible]78·[illegible]	[illegible]3·[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]88·3	[illegible]3·06	[illegible]70·[illegible]	[illegible]2·[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]80·5	[illegible]2·77	[illegible]63·0	[illegible]2·[illegible]	[illegible]	[illegible]	[illegible]
[illegible]·15	[illegible]72·9	[illegible]2·50	[illegible]56·[illegible]	[illegible]2·[illegible]	[illegible]	[illegible]	[illegible]
[illegible]·38	[illegible]66·0	12·24	150·0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]·93	[illegible]59·[illegible]	12·01	144·[illegible]	11·88	141·1	[illegible]	[illegible]
[illegible]·39	[illegible]53·[illegible]	11·78	138·9	11·66	[illegible]	[illegible]	[illegible]
[illegible]·17	148·2	11·57	134·0	11·45	[illegible]	[illegible]	[illegible]
[illegible]·96	143·1	11·37	129·4	11·25	[illegible]	[illegible]	[illegible]
[illegible]·7[illegible]	138·4	11·18	125·1	11·07	122·5	[illegible]	[illegible]
[illegible]·57	134·0	11·01	121·2	10·89	118·6	[illegible]	[illegible]
[illegible]·39	129·8	10·83	117·4	10·72	115·0	[illegible]	[illegible]
[illegible]·22	126·0	10·67	114·0	10·56	111·6	[illegible]	[illegible]
$^{*}F_{1}G_{1}$		$^{*}H_{1}$		[illegible]		[illegible]	

[illegible] distinguishing letter in each column refers to the condition[illegible] [illegible] the pitches and surfaces are applicable; these condition[illegible] [illegible]eir distinguishing letters, will be found immediately pr[illegible] [illegible]hese *Tables*.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{31}{32}$ inch thick.

Pressure per sq. in.	*A_1 Pitch	*A_1 Surface	*B_1 Pitch	*B_1 Surface	*C_1 Pitch	*C_1 Surface	*D_1 Pitch	*D_1 Surface	*E_1 Pitch	*E_1 Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	...	...
65	...	...	...	...	...	...	...	...	20·61	424·8
70	...	...	...	...	...	...	...	...	19·87	394·9
75	...	...	...	...	...	...	20·35	414·3	19·21	369·0
80	...	...	...	...	20·77	431·3	19·72	388·8	18·61	346·3
85	...	...	...	...	20·15	406·3	19·14	366·3	18·06	326·2
90	...	...	...	...	19·60	384·1	18·61	346·3	17·56	308·5
95	...	...	...	...	19·08	364·2	18·12	328·4	17·10	292·5
100	...	...	...	...	18·61	346·3	17·67	312·2	16·68	278·2
105	...	...	...	...	18·16	330·1	17·25	297·6	16·28	265·[illegible]
110	...	...	...	...	17·75	315·3	16·86	284·4	15·92	253·[illegible]
115	...	...	...	...	17·37	301·9	16·50	272·3	15·58	242·[illegible]
120	...	...	20·77	431·3	17·01	289·5	16·16	261·2	15·26	232·[illegible]
125	...	...	20·35	414·3	16·68	278·2	15·84	251·0	14·96	223[illegible]
130	20·61	424·8	19·96	398·6	16·36	267·7	15·54	241·6	14·67	215[illegible]
135	20·23	409·3	19·60	384·1	16·06	258·0	15·26	232·8	14·41	207[illegible]
140	19·87	394·9	19·25	370·6	15·78	249·0	14·99	224·7	14·15	200[illegible]
145	19·53	381·5	18·92	358·0	15·51	240·6	14·73	217·2	13·92	193[illegible]
150	19·21	369·0	18·61	346·3	15·26	232·8	14·49	210·1	13·69	187[illegible]
155	18·90	357·2	18·31	335·3	15·01	225·5	14·26	203·6	13·47	181[illegible]
160	18·61	346·3	18·02	325·0	14·78	218·6	14·05	197·4	13·27	176[illegible]
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the condition [illegible] to which the pitches and surfaces are applicable; these conditions, *with their distinguishing letters, will be found immediately preceding these Tables.*

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Steel Plate $\frac{3\frac{1}{2}}{32}$ inch thick.

Pressure per sq. in.	*F_1G_1		*H_1		*rG_1		*I_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	20·91	437·2
30	...	...	...	...	...	...	19·11	365·3
35	...	...	...	...	...	...	17·72	314·0
40	...	...	...	...	...	...	16·60	275·5
45	...	...	20·35	414·3	20·13	405·3	15·67	245·5
50	20·35	414·3	19·32	373·5	19·11	365·3	14·88	221·6
55	19·42	377·2	18·44	340·1	18·24	332·7	14·21	202·0
60	18·61	346·3	17·67	312·2	17·47	305·4	13·62	185·6
65	17·89	320·1	16·99	288·7	16·80	282·4	13·11	171·8
70	17·25	297·6	16·38	268·5	16·20	262·6	12·65	160·0
75	16·68	278·2	15·84	251·0	15·67	245·5	12·23	149·7
80	16·16	261·2	15·35	235·7	15·18	230·6	11·86	140·7
85	15·69	246·2	14·90	222·1	14·74	217·3	11·52	132·8
90	15·26	232·8	14·49	210·1	14·34	205·6	11·21	125·7
95	14·86	220·9	14·12	199·4	13·97	195·1	10·93	119·4
100	14·49	210·1	13·77	189·7	13·62	185·6	10·66	113·8
105	14·15	200·4	13·45	181·0	13·30	177·1	10·42	108·6
110	13·84	191·6	13·15	173·0	13·01	169·3	10·19	104·0
115	13·54	183·5	12·87	165·7	12·73	162·2	9·98	99·7
120	13·27	176·1	12·61	159·1	12·48	155·7	9·79	95·8
125	13·01	169·3	12·37	153·0	12·23	149·7	9·60	92·2
130	12·77	163·0	12·14	147·3	12·01	144·2	9·42	88·8
135	12·54	157·2	11·92	142·1	11·79	139·1	9·26	85·8
140	12·36	152·8	11·71	137·2	11·59	134·3	9·11	83·0
145	12·11	146·8	11·52	132·7	11·39	129·9	8·96	80·3
150	11·92	142·1	11·33	128·5	11·21	125·7	8·82	77·8
155	11·73	137·7	11·16	124·5	11·04	121·9	8·69	75·5
160	11·56	133·6	10·99	120·8	10·87	118·3	8·56	73·3
	*F_1G_1		*H_1		*rG_1		*I_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate 1 inch thick.

Pressure per sq. in.	$*A_1$		$*B_1$		$*C_1$		$*D_1$		$*E_1$	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	...	...
65	...	...	...	...	...	...	...	...	...	...
70	...	...	...	...	...	...	...	...	20·46	418·8
75	...	...	...	...	...	...	20·96	439·5	19·78	391·3
80	...	...	...	...	...	...	20·30	412·4	19·16	367·2
85	...	...	...	...	20·76	431·0	19·71	388·5	18·60	346·0
90	...	...	...	...	20·18	407·3	19·16	367·2	18·08	327·1
95	...	...	...	...	19·65	386·2	18·66	348·2	17·61	310·2
100	...	...	...	...	19·16	367·2	18·19	331·1	17·17	295·0
105	...	...	...	...	18·71	350·0	17·76	315·6	16·77	281·2
110	...	...	...	...	18·28	334·4	17·36	301·5	16·39	268·7
115	...	...	...	...	17·89	320·1	16·99	288·7	16·04	257·3
120	...	...	...	...	17·52	307·0	16·64	276·9	15·71	246·8
125	...	...	...	...	17·17	295·0	16·31	266·1	15·40	237·2
130	...	...	20·56	422·8	16·85	283·8	16·00	256·0	15·11	228·3
135	20·83	434·1	20·18	407·3	16·54	273·5	15·71	246·8	14·83	220·0
140	20·46	418·8	19·82	393·0	16·25	264·0	15·43	238·2	14·57	212·4
145	20·11	404·6	19·48	379·7	15·97	255·1	15·17	230·2	14·32	205·3
150	19·78	391·3	19·16	367·2	15·71	246·8	14·92	222·7	14·09	198·6
155	19·46	378·9	18·85	355·5	15·46	239·0	14·68	215·7	13·87	192·4
160	19·16	367·2	18·56	344·6	15·22	231·7	14·46	209·2	13·66	186·6
	$*A_1$		$*B_1$		$*C_1$		$*D_1$		$*E_1$	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate 1 inch thick.

lbs. per sq. in.	*F_1G_1 Pitch	*F_1G_1 Surface	*H_1 Pitch	*H_1 Surface	*$F G_1$ Pitch	*$F G_1$ Surface	*I_1 Pitch	*I_1 Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	.	...
15	...	...	...	...	...	...	...	
20	...	...	...	...	...	...	.	...
25	...	...	...	...	...	...		
30	...	...	...	...	...	...	[illegible]	[illegible]
35	...	...	...	...	...	.	[illegible]	[illegible]
40	...	...	...	...	...	.	[illegible]	[illegible]
45	...	...	20·96	439·5	20·73	[illegible]	[illegible]	[illegible]
50	20·96	439·5	19·90	396·1	19·68	387·4	[illegible]	[illegible]
55	20·00	400·0	18·99	360·6	[illegible]	[illegible]	[illegible]	[illegible]
60	19·16	367·2	18·19	331·1	[illegible]	[illegible]	[illegible]	[illegible]
65	18·42	339·4	17·49	306·1	[illegible]	[illegible]	[illegible]	[illegible]
70	17·76	315·6	16·87	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75	17·17	295·0	16·31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
80	16·64	276·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
85	16·15	261·0	15·24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
90	15·71	246·8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
95	15·30	234·1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
100	14·92	222·7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
105	14·57	212·4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
110	14·25	203·0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
115	13·94	194·4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
120	13·66	186·6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
125	13·39	179·4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
130	13·14	172·7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
135	12·90	166·5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
140	12·68	160·8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
145	12·47	155·5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
150	12·26	150·2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
155	12·07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
160	11·89	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*F_1G_1 [illegible]

* The disting[illegible] which the [illegible] with their disting[illegible] ding these Table [illegible]

Pressures, Pitches, and Surfaces.

Steel Plate $1\frac{1}{32}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	...	...
65	...	...	...	...	...	...	...	...	...	...
70	...	...	...	...	...	...	...	...	21·06	443·5
75	...	...	...	...	...	...	...	...	20·35	414·3
80	...	...	...	...	...	...	20·89	436·6	19·71	388·8
85	...	...	...	...	...	...	20·28	411·3	19·13	366·2
90	...	...	...	...	20·76	431·3	19·71	388·8	18·60	346·2
95	...	...	...	...	20·22	408·9	19·20	368·6	18·12	328·3
100	...	...	...	...	19·71	388·8	18·72	350·5	17·67	312·2
105	...	...	...	...	19·25	370·5	18·28	334·1	17·25	297·6
110	...	...	...	...	18·81	354·0	17·86	319·2	16·86	284·4
115	...	...	...	...	18·40	338·8	17·48	305·5	16·50	272·3
120	...	...	...	...	18·02	325·0	17·12	293·1	16·16	261·2
125	...	...	...	...	17·67	312·2	16·78	281·6	15·84	251·0
130	...	...	...	...	17·33	300·4	16·46	271·0	15·54	241·5
135	...	...	20·76	431·3	17·01	289·5	16·16	261·2	15·26	232·6
140	...	...	20·40	416·1	16·71	279·4	15·87	252·0	14·99	224·7
145	20·69	428·4	20·05	402·0	16·43	270·0	15·60	243·6	14·73	217·2
150	20·35	414·3	19·71	388·8	16·16	261·2	15·35	235·6	14·49	210·1
155	20·03	401·1	19·40	376·4	15·90	252·9	15·10	228·2	14·26	203·5
160	19·71	388·8	19·10	364·8	15·66	245·2	14·87	221·3	14·05	197·4
	*A_1		*B_1		*C_1		*D_1		*E_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, *with their* distinguishing letters, will be found immediately *preceding these* Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $1\frac{1}{32}$ inch thick.

Pressure per sq. in.	*F_1G_1		*H_1		*r G_1		*I_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	20·25	410·2
35	...	...	...	...	...	...	18·77	352·5
40	...	...	...	...	...	...	17·58	309·1
45	...	...	...	...	...	...	16·59	275·5
50	...	...	20·48	419·4	20·25	410·2	15·76	248·5
55	20·58	423·6	19·54	381·8	19·32	373·5	15·05	226·5
60	19·71	388·8	18·72	350·5	18·51	342·8	14·42	208·1
65	18·95	359·3	18·00	324·0	17·80	316·9	13·87	192·5
70	18·28	334·1	17·35	301·3	17·16	294·7	13·38	179·2
75	17·67	312·2	16·78	281·6	16·59	275·5	12·95	167·7
80	17·12	293·1	16·26	264·3	16·08	258·6	12·55	157·5
85	16·62	276·2	15·78	249·1	15·61	243·7	12·19	148·6
90	16·16	261·2	15·35	235·6	15·18	230·5	11·86	140·7
95	15·74	247·7	14·95	223·5	14·79	218·7	11·56	133·6
100	15·35	235·6	14·58	212·7	14·42	208·1	11·28	127·2
105	14·99	224·7	14·24	202·8	14·09	198·5	11·02	121·5
110	14·65	214·8	13·92	193·9	13·77	189·7	10·78	116·2
115	14·34	205·7	13·63	185·7	13·48	181·7	10·55	111·4
120	14·05	197·4	13·35	178·2	13·20	174·4	10·34	107·0
125	13·77	189·7	13·09	171·3	12·95	167·7	10·15	103·0
130	13·51	182·6	12·84	165·0	12·70	161·4	9·96	99·2
135	13·27	176·1	12·61	159·1	12·47	155·7	9·79	95·8
140	13·04	170·0	12·39	153·6	12·26	150·3	9·62	92·6
145	12·82	164·4	12·18	148·5	12·05	145·3	9·46	89·6
150	12·61	159·1	11·99	143·8	11·86	140·7	9·32	86·8
155	12·41	154·1	11·80	139·3	11·68	136·4	9·17	84·2
160	12·23	149·5	11·62	135·1	11·50	132·3	9·04	81·7
	*F_1G_1		*H_1		*r G_1		*I_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding *these Tables.*

Pressures, Pitches, and Surfaces.

Steel Plate $1\frac{1}{16}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitc
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	...
65	...	...	...	...	...	...	...	...	...
70	...	...	...	...	...	...	...	...	...
75	...	...	...	...	...	...	...	...	20·9
80	...	...	...	...	...	...	...	...	20·2
85	...	...	...	...	...	...	20·85	434·8	19·6
90	...	...	...	...	...	...	20·27	411·0	19·1
95	...	...	...	...	20·79	432·3	19·74	389·6	18·6
100	...	...	...	...	20·27	411·0	19·24	370·5	18·1
105	...	...	...	...	19·79	391·7	18·79	353·1	17·7
110	...	...	...	...	19·34	374·1	18·36	337·3	17·3
115	...	...	...	...	18·92	358·1	17·97	322·9	16·9
120	...	...	...	...	18·53	343·5	17·60	309·7	16·6
125	...	...	...	...	18·16	330·0	17·25	297·6	16·2
130	...	...	...	...	17·82	317·5	16·92	286·3	15·9
135	...	...	...	...	17·49	306·0	16·61	276·0	15·6
140	...	...	20·97	439·9	17·18	295·2	16·32	266·3	15·4
145	...	...	20·61	424·9	16·89	285·3	16·04	257·3	15·1
150	20·92	438·0	20·27	411·0	16·61	276·0	15·78	249·0	14·9
155	20·59	424·0	19·94	397·9	16·35	267·2	15·53	241·1	14·6
160	20·27	411·0	19·63	385·6	16·09	259·1	15·29	233·8	14·4
	*A_1		*B_1		*C_1		*D_1		

* The distinguishing letter in each column refers to the con
to which the pitches and surfaces are applicable ; these cond
with their distinguishing letters, will be found immediatel
ceding these Tables.

FLAT SURFACES.

Pressures, Pitches, and Surfaces.

Steel Plate $1\frac{1}{16}$ inch thick.

TABLE No. 107 *continued.*

per sq. in.	*F_1G_1 Pitch	*F_1G_1 Surface	*H_1 Pitch	*H_1 Surface	*r G_1 Pitch	*r G_1 Surface	*I_1 Pitch	*I_1 Surface
s.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	20·82	433·6
5	...	...	...	...	...	...	19·30	372·5
0	...	...	...	...	...	...	18·07	326·7
5	...	...	...	...	...	...	17·06	291·1
0	...	...	21·05	443·4	20·82	433·6	16·20	262·6
5	...	...	20·09	403·6	19·87	394·8	15·46	239·2
0	20·27	411·0	19·24	370·5	19·03	362·4	14·82	219·8
5	19·49	379·8	18·50	342·4	18·20	334·9	14·26	203·3
0	18·79	353·1	17·84	318·4	17·64	311·4	13·75	189·2
5	18·16	330·0	17·25	297·6	17·06	291·1	13·30	177·0
30	17·60	309·7	16·68	278·2	16·53	273·3	12·89	166·3
35	17·08	291·8	16·22	263·2	16·05	257·5	12·52	156·9
90	16·61	276·0	15·78	249·0	15·60	243·5	12·18	148·5
95	16·18	261·7	15·37	236·2	15·20	231·0	11·87	141·0
00	15·78	249·0	14·99	224·7	14·82	219·8	11·58	134·3
05	15·40	237·4	14·63	214·2	14·48	209·6	11·32	128·1
10	15·06	226·9	14·31	204·8	14·15	200·4	11·07	122·6
15	14·74	217·3	14·00	196·0	13·85	191·9	10·84	117·5
20	14·44	208·5	13·72	188·2	13·57	184·2	10·62	112·9
25	14·15	200·4	13·45	180·9	13·30	177·0	10·42	108·6
30	13·89	192·9	[illegible]	174·2	[illegible]	[illegible]	10·22	104·6
35	13·63	186·0	[illegible]	[illegible]	[illegible]	[illegible]	10·06	101·9
40	13·40	179·5	[illegible]	[illegible]	[illegible]	[illegible]	9·88	97·6
45	13·17	173·5	[illegible]	[illegible]	[illegible]	[illegible]	9·72	94·4
50	12·96	168·0	[illegible]	[illegible]	[illegible]	[illegible]	9·56	91·5
55	12·75	162·7	[illegible]	[illegible]	[illegible]	[illegible]	9·42	88·7
60	12·56	157·8	[illegible]	[illegible]	[illegible]	[illegible]	9·28	86·1
	*F_1G_1		*H_1		*rG_1		*I_1	

* The distinguishing letter in each column refers to the conditions to which the pitches and surfaces are applicable; these conditions, with their distinguishing letters, will be found immediately preceding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $1\frac{3}{32}$ inch thick.

Pressure per sq. in.	*A₁		*B₁		*C₁		*D₁		
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitc
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	...
65	...	...	...	...	...	...	...	...	...
70	...	...	...	...	...	...	...	...	...
75	...	...	...	...	...	...	...	...	...
80	...	...	...	...	...	...	...	...	20·8
85	...	...	...	...	...	...	...	...	20·2
90	...	...	...	...	...	...	20·82	433·8	19·6
95	...	...	...	...	...	...	20·28	411·2	19·1
100	...	...	...	...	20·82	433·8	19·77	391·0	18·6
105	...	...	...	...	20·33	413·4	19·30	372·6	18·2
110	...	...	...	...	19·87	394·9	18·86	356·0	17·8
115	...	...	...	...	19·44	378·0	18·46	340·8	17·4
120	...	...	...	...	19·04	362·5	18·08	326·8	17·0
125	...	...	...	...	18·66	348·2	17·72	314·0	16·7
130	...	...	...	...	18·30	335·0	17·38	302·1	16·4
135	...	...	...	...	17·96	322·8	17·06	291·2	16·1
140	...	...	...	...	17·65	311·5	16·76	281·0	15·8
145	...	...	...	...	17·35	301·0	16·47	271·5	15·5
150	...	...	20·82	433·8	17·06	291·2	16·20	262·6	15·3
155	...	...	20·49	420·0	16·79	282·0	15·95	254·4	15·0
160	...	...	20·17	407·0	16·53	273·3	15·70	246·6	14·8
	*A₁		*B₁		*C₁		*D₁		

* The distinguishing letter in each column refers to the con to which the pitches and surfaces are applicable ; these con with their distinguishing letters, will be found immediate *ceding these Tables.*

FLAT SURFACES.

TABLE No. 108 *continued.*

Pressures, Pitches, and Surfaces.

Steel Plate $1\frac{3}{32}$ inch thick.

per sq. in.	*F_1G_1		*H_1		*r G_1		*I_1	
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
s.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	...	...
0	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	19·83	393·2
0	...	...	...	...	...	...	18·57	344·8
5	...	...	...	...	...	...	17·52	307·1
0	...	...	...	...	...	...	16·64	277·0
5	...	...	20·64	426·0	20·41	416·7	15·88	252·4
0	20·82	433·8	19·77	391·0	19·55	382·4	15·22	231·8
5	20·02	400·9	19·01	361·4	18·80	353·5	14·64	214·5
70	19·30	372·6	18·33	336·0	18·13	328·6	14·12	199·6
75	18·66	348·2	17·72	314·0	17·52	307·1	13·66	186·7
80	18·08	326·8	17·16	294·7	16·98	288·3	13·24	175·4
85	17·55	307·9	16·66	277·7	16·48	271·7	12·86	165·4
90	17·06	291·2	16·20	262·6	16·03	256·9	12·51	156·5
95	16·62	276·1	15·78	249·1	15·61	243·7	12·19	148·6
00	16·20	262·6	15·39	237·0	15·22	231·8	11·89	141·5
05	15·82	250·4	15·03	226·0	14·87	221·1	11·62	135·0
10	15·47	239·3	14·69	216·0	14·53	211·3	11·36	129·2
15	15·14	229·2	14·38	206·8	14·22	202·4	11·12	123·8
20	14·83	219·9	14·09	198·5	13·93	194·2	10·90	118·9
25	14·53	211·3	13·81	190·8	13·66	186·7	10·69	114·4
30	14·26	203·4	13·55	183·7	13·40	179·7	10·50	110·2
35	14·00	196·0	13·30	177·1	13·16	173·3	10·31	106·3
40	13·76	189·3	13·07	171·0	12·93	167·3	10·14	102·8
45	13·52	183·0	12·85	165·3	12·72	161·7	9·97	99·4
50	13·30	177·1	12·65	160·0	12·51	156·5	9·81	96·3
55	13·10	171·6	12·45	155·0	12·31	151·7	9·66	93·4
60	12·90	166·4	12·26	150·3	12·13	147·1	9·52	90·7
	*F_1G_1		*H_1		*r G_1		*I_1	

* The distinguishing letter in each column refers to the conditions o which the pitches and surfaces are applicable; these conditions, vith their distinguishing letters, will be found immediately pre-eding these Tables.

Pressures, Pitches, and Surfaces.

Steel Plate $1\frac{1}{8}$ inch thick.

Pressure per sq. in.	*A_1		*B_1		*C_1		*D_1		*E
	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch
lbs.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	...
65	...	...	...	..	...	...	...	...	...
70	...	...	...	...	...	...	...	...	...
75	...	...	...	...	...	...	...	...	...
80	...	...	...	...	...	...	...	...	...
85	...	...	...	...	...	...	...	...	20·75
90	...	...	...	...	...	...	...	...	20·17
95	...	...	...	...	...	...	20·82	433·5	19·64
100	...	...	...	...	...	...	20·30	412·1	19·15
105	...	...	...	...	20·87	435·7	19·81	392·7	18·70
110	...	...	...	...	20·40	416·2	19·37	375·2	18·28
115	...	...	...	...	19·96	398·3	18·95	359·1	17·88
120	...	...	...	...	19·54	382·0	18·55	344·4	17·51
125	...	...	...	...	19·15	367·0	18·19	330·9	17·17
130	...	...	...	...	18·79	353·1	17·84	318·4	16·84
135	...	...	...	...	18·44	340·2	17·51	306·8	16·53
140	...	...	...	...	18·12	328·3	17·20	296·0	16·24
145	...	...	...	...	17·81	317·2	16·91	286·0	15·96
150	...	...	...	...	17·51	306·8	16·63	276·7	15·70
155	...	...	...	...	17·23	297·1	16·37	268·0	15·45
160	...	...	20·71	429·0	16·97	288·0	16·12	259·8	15·22
	*A_1		*B_1		*C_1		*D_1		*E

* The distinguishing letter in each column refers to the condi to which the pitches and surfaces are applicable; these condi with their distinguishing letters, will be found immediately *ceding these* Tables.

FLAT SURFACES.

Table No. 109 *continued.*

Pressures, Pitches, and Surfaces.

Steel Plate $1\frac{1}{8}$ inch thick.

*F_1G_1		*H_1		*r G_1		*I_1	
Pitch	Surface	Pitch	Surface	Pitch	Surface	Pitch	Surface
ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.	ins.	sq. ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	20·35	414·4
...	...	...	...	...	...	19·06	363·3
...	...	...	...	...	...	17·99	323·6
...	...	...	...	...	...	17·08	291·9
...	...	...	...	20·95	439·2	16·30	265·9
...	...	20·30	412·1	20·07	403·1	15·62	244·2
20·55	422·5	19·51	380·8	19·30	372·5	15·03	225·9
19·81	392·7	18·81	354·1	18·61	346·3	14·50	210·2
19·15	367·0	18·19	330·9	17·99	323·6	14·02	196·6
18·55	344·4	17·62	310·5	17·43	303·8	13·59	184·6
18·01	324·5	17·10	292·6	16·92	286·3	13·19	174·1
17·51	306·8	16·63	276·7	16·45	270·7	12·84	164·8
17·05	291·0	16·20	262·5	16·02	256·8	12·51	156·4
16·63	276·7	15·80	249·6	15·62	244·2	12·20	148·9
16·24	263·8	15·43	238·0	15·26	232·9	11·92	142·1
15·87	252·1	15·08	227·5	14·92	222·6	11·66	135·9
15·53	241·4	14·76	217·8	14·60	213·1	11·41	130·3
15·22	231·6	14·45	209·0	14·30	204·5	11·18	125·1
14·92	222·6	14·17	200·9	14·02	196·6	10·97	120·3
14·63	214·2	13·90	193·4	13·75	189·2	10·76	115·9
14·37	206·5	13·65	186·5	13·50	182·4	10·57	111·8
14·12	199·3	13·42	180·0	13·27	176·1	10·39	108·1
13·88	192·7	13·19	174·0	13·05	170·3	10·22	104·5
13·65	186·5	12·97	168·4	12·84	164·8	10·06	101·3
13·44	180·6	12·77	163·2	12·63	159·7	9·91	98·2
13·23	175·2	12·58	158·2	12·44	154·9	9·76	95·3
*F_1G_1		*H_1		*r G_1		*I_1	

* The distinguishing letter in each column refers to the conditions which the pitches and surfaces are applicable; these conditions, th their distinguishing letters, will be found immediately preling *these Tables.*

R

PRESSURES, GREATEST SURFACES AND SIZES OF STAYS.

Stress on *solid* STEEL screwed Stays which have *not* been welded or worked in the fire 9000 lbs. per square inch of net section.

The following notes will facilitate the use of the Tables which immediately follow, numbered 110 to 114.

(1) If the working pressure be 150 lbs., the surface to be supported by one stay 252 square inches, and the size of stay be required :—

Then, opposite 150 lbs. in Table No. 113, the surface, 252 square inches, is found under the diameter 2 5/16 inches, and area 4·2 square inches, which is the size of stay required.

(2) If the surface be 160 square inches, the stay 1⅞ inch diameter, area 2·7612 square inches, and working pressure be required :—

Then, in Table No. 112, 1⅞ inch diameter stay is found, and in the column under the area 2·7612 square inches and 1⅞ inch diameter, the surface is 160·3 square inches, and opposite it the pressure is 155 lbs., which is the working pressure suitable.

(3) If the stay be 1 inch diameter, the area ·7854 square inch, and the working pressure is to be 80 lbs., and the greatest surface for such size of stay and working pressure be required :—

Then, in Table No. 110, 1 inch stay is found, and opposite 80 lbs. in the column for 1 inch diameter, area ·7854 inch, the surface is 88·3 square inches, which is the surface suitable for such stay and pressure.

When the surface is not found opposite the pressure, it will be on the side of safety to adopt the larger size of stay, over the next greater surface on the right.

The diameter is always the net effective diameter, or diameter at the bottom of the thread, and the area the net sectional area at the smallest part of the stay.

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

TABLE No. 110.

ress on *solid* Steel screwed Stays, which have *not* been welded or worked in the fire, 9000 lbs. per square inch of net section.*

	Area 0·1963 sq. in.	Area 0·2485 sq. in.	Area 0·3068 sq. in.	Area 0·3712 sq. in.	Area 0·4417 sq. in.	Area 0·5184 sq. in.	Area 0·6013 sq. in.	Area 0·6902 sq. in.	Area 0·7854 sq. in.
	Diam. ½ inch.	Diam. $^{9}/_{16}$ inch.	Diam. ⅝ inch.	Diam. $^{11}/_{16}$ inch.	Diam. ¾ inch.	Diam. $^{13}/_{16}$ inch.	Diam. ⅞ inch.	Diam. $^{15}/_{16}$ inch.	Diam. 1 inch.
	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	353·3	447·3	552·2	668·1	795·0	933·1	...	...	...
0	176·6	223·6	276·1	334·0	397·5	466·5	541·1	621·1	706·8
5	117·7	149·1	184·0	222·7	265·0	311·0	360·7	414·1	471·2
0	88·3	111·8	138·0	167·0	198·7	233·2	270·5	310·5	353·4
5	70·6	89·4	110·4	133·6	159·0	186·6	216·4	248·4	282·7
0	58·8	74·5	92·0	111·3	132·5	155·5	180·3	207·0	235·6
5	50·4	63·9	78·8	95·4	113·5	133·3	154·6	177·4	201·9
0	44·1	55·9	69·0	83·5	99·3	116·6	135·2	155·2	176·7
5	39·2	49·7	61·3	74·2	88·3	103·6	120·2	138·0	157·0
0	35·3	44·7	55·2	66·8	79·5	93·3	108·2	124·2	141·2
5	32·1	40·6	50·2	60·7	72·2	84·8	98·3	112·9	128·5
0	29·4	37·2	46·0	55·6	66·2	77·7	90·1	103·5	117·8
5	27·1	34·4	42·4	51·3	61·1	71·7	83·2	95·5	108·7
0	25·2	31·9	39·4	47·7	56·7	66·6	77·3	88·7	100·9
75	23·5	29·8	36·8	44·5	53·0	62·2	72·1	82·8	94·2
30	22·0	27·9	34·5	41·7	49·6	58·3	67·6	77·6	88·3
35	20·7	26·3	32·4	39·3	46·7	54·9	63·6	73·0	83·1
90	19·6	24·8	30·6	37·1	44·1	51·8	60·1	69·0	78·5
95	18·5	23·5	29·0	35·1	41·8	49·1	56·9	65·3	74·4
00	17·6	22·3	27·6	33·4	39·7	46·6	54·1	62·1	70·6
05	16·8	21·3	26·2	31·8	37·8	44·4	51·5	59·1	67·3
10	16·0	20·3	25·0	30·3	36·1	42·4	49·1	56·4	64·2
15	15·3	19·4	24·0	29·0	34·5	40·5	47·0	54·0	61·4
20	14·7	18·6	23·0	27·8	33·1	38·8	45·0	51·7	58·9
25	14·1	17·8	22·0	26·7	31·8	37·3	43·2	49·7	56·5
30	13·5	17·2	21·2	25·6	30·5	35·8	41·6	47·7	54·3
35	13·0	16·5	20·4	24·7	29·4	34·5	40·0	46·0	52·3
40	12·6	15·9	19·7	23·8	28·3	33·3	38·6	44·3	50·4
45	...	15·4	19·0	23·0	27·4	32·1	37·3	42·8	48·7
50	...	14·9	18·4	22·2	26·5	31·1	36·0	41·4	47·1
55	...	14·4	17·8	21·5	25·6	30·1	34·9	40·0	45·6
30	...	13·9	17·2	20·8	24·8	29·6	33·8	38·8	44·1

* 9000 lbs. per square inch of net section is the greatest working stress to ich *solid steel screwed stays* should be subjected. Steel stays which have *n welded or worked in the fire* are *not* reliable, and should *not* be used.

Stress on *solid* Steel screwed Stays, which have *not* been welded o worked in the fire, 9000 lbs. per square inch of net section.*

Pressure per square inch.	Area 0·8866 sq. in. Diam. $1\frac{1}{16}$ inch.	Area 0·9940 sq. in. Diam. $1\frac{1}{8}$ inch.	Area 1·1075 sq. in. Diam. $1\frac{3}{16}$ inch.	Area 1·2272 sq. in. Diam. $1\frac{1}{4}$ inch.	Area 1·3530 sq. in. Diam. $1\frac{5}{16}$ inch.	Area 1·4849 sq. in. Diam. $1\frac{3}{8}$ inch.	Area 1·6230 sq. in. Diam. $1\frac{7}{16}$ inch.	Area 1·7671 sq. in. Diam. $1\frac{1}{2}$ inch.	Ar 1·9 sq. Dia 1 inc
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surf sq.
5	...	...	...	...	...	...	...	...	..
10	797·9	894·6	996·7	...	...	...	...	...	..
15	531·9	596·4	664·5	736·3	811·8	890·9	973·8	...	..
20	398·9	447·3	498·3	552·2	608·9	668·2	730·3	795·1	862
25	319·1	357·8	398·7	441·7	487·0	534·5	584·2	636·1	690
30	265·9	298·2	332·2	368·1	405·9	445·4	486·9	530·1	575
35	227·9	255·6	284·7	315·5	347·9	381·8	417·3	454·3	493
40	199·4	223·6	249·1	276·1	304·4	334·1	365·1	397·5	431
45	177·3	198·8	221·5	245·4	270·6	296·9	324·6	353·4	383
50	159·5	178·9	199·3	220·8	243·5	267·2	292·1	318·0	345
55	145·0	162·6	181·2	200·8	221·4	242·9	265·5	289·1	313
60	132·9	149·1	166·1	184·0	202·9	222·7	243·4	265·0	287
65	122·7	137·6	153·3	169·9	187·3	205·6	224·7	244·6	265
70	113·9	127·8	142·3	157·7	173·9	190·9	208·6	227·1	246
75	106·3	119·2	132·9	147·2	162·3	178·1	194·7	212·0	230
80	99·7	111·8	124·5	138·0	152·2	167·0	182·5	198·7	215
85	93·8	105·2	117·2	129·9	143·2	157·2	171·8	187·1	203
90	88·6	99·4	110·7	122·7	135·3	148·4	162·3	176·7	191
95	83·9	94·1	104·9	116·2	128·1	140·6	153·7	167·4	181
100	79·7	89·4	99·6	110·4	121·7	135·6	146·0	159·0	172
105	75·9	85·2	94·9	105·1	115·9	127·2	139·1	151·4	164
110	72·5	81·3	90·6	100·4	110·7	121·4	132·7	144·5	156
115	69·3	77·7	86·6	96·0	105·8	116·2	127·0	138·2	150
120	66·4	74·5	83·0	92·0	101·4	111·3	121·7	132·5	143
125	63·8	71·5	79·7	88·3	97·4	106·9	116·8	127·2	138
130	61·3	68·8	76·6	84·9	93·6	102·8	112·3	122·3	132
135	59·1	66·2	73·8	81·8	90·2	98·9	108·2	117·8	127
140	56·9	63·9	71·1	78·8	86·9	95·4	104·3	113·5	123
145	55·0	61·6	68·7	76·1	83·9	92·1	100·7	109·6	119
150	50·1	59·6	66·4	73·6	81·1	89·0	97·3	106·0	115
155	51·4	57·7	64·3	71·2	78·5	86·2	94·2	102·6	111
160	49·8	55·9	62·2	69·0	76·1	83·5	91·2	99·3	107

* 9000 lbs. per square inch of net section is the greatest working stress which *solid* steel screwed stays should be subjected. Steel stays which ha been welded or worked in the fire are not reliable, and should not be used.

Stress on *Solid* Steel Screwed Stays, which have *not* been welded or worked in the fire, 9000 lbs. per square inch of net section.*

Pressure per square inch.	Area 2·0739 sq. ins.	Area 2·2365 sq. ins.	Area 2·4053 sq. ins.	Area 2·5802 sq. ins.	Area 2·7612 sq. ins.	Area 2·9483 sq. ins.	Area 3·1416 sq. ins.	Area 3·3410 sq. ins.	Area 3·5466 sq. ins.
	Diam. $1\frac{5}{8}$ inch.	Diam. $1\frac{11}{16}$ inch.	Diam. $1\frac{3}{4}$ inch.	Diam. $1\frac{13}{16}$ inch.	Diam. $1\frac{7}{8}$ inch.	Diam. $1\frac{15}{16}$ inch.	Diam. 2 inches.	Diam. $2\frac{1}{16}$ inches.	Diam. $2\frac{1}{8}$ inches.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	933·2	...	...	...	...	...	...	...	...
25	746·6	805·1	865·9	928·8	994·0	...	...	...	...
30	622·1	670·9	721·5	774·0	828·3	884·4	942·4	...	...
35	533·2	575·1	618·5	663·4	710·0	758·1	807·8	859·1	911·9
40	466·6	503·2	541·1	580·5	621·2	663·3	706·8	751·7	797·9
45	414·7	447·3	481·0	516·0	552·2	589·6	628·3	668·2	709·3
50	373·3	402·5	432·9	464·4	497·0	530·6	565·4	601·3	638·3
55	339·3	365·9	393·5	422·2	451·8	482·4	514·0	546·7	580·3
60	311·0	335·4	360·7	387·0	414·1	442·2	471·2	501·1	531·9
65	287·1	309·6	333·0	357·2	382·3	408·2	434·9	462·6	491·0
70	266·6	287·5	309·2	331·7	355·0	379·0	403·9	429·5	455·9
75	248·8	268·3	288·6	309·6	331·3	353·7	376·9	400·9	425·5
80	233·3	251·6	270·5	290·2	310·6	331·6	353·4	375·8	398·9
85	219·5	236·8	254·6	273·1	292·3	312·1	332·6	353·7	375·5
90	207·3	223·6	240·5	258·0	276·1	294·8	314·1	334·1	354·6
95	196·4	211·8	227·8	244·4	261·5	279·3	297·6	316·5	335·9
100	186·6	201·2	216·4	232·2	248·5	265·3	282·7	300·6	319·1
105	177·7	191·7	206·1	221·1	236·6	252·7	269·2	286·3	303·9
110	169·6	182·9	196·7	211·0	225·9	241·2	257·0	273·3	290·1
115	162·3	175·0	188·2	201·9	216·0	230·7	245·8	261·4	277·5
120	155·5	167·7	180·3	193·5	207·0	221·1	235·6	250·5	265·9
125	149·3	161·0	173·1	185·7	198·8	212·2	226·1	240·5	255·3
130	143·5	154·8	166·5	178·6	191·1	204·1	217·4	231·3	245·5
135	138·2	149·1	160·3	172·0	184·0	196·5	209·4	222·7	236·4
140	133·3	143·7	154·6	165·8	177·5	189·5	201·9	214·7	227·9
145	128·7	138·8	149·2	160·1	171·3	182·9	194·9	207·3	220·1
150	124·4	134·1	144·3	154·8	165·6	176·8	188·4	200·4	212·7
155	120·4	129·8	139·6	149·8	160·3	171·1	182·4	193·9	205·9
160	116·6	125·8	135·2	145·1	155·3	165·8	176·7	187·9	199·4

* 9000 lbs. per square inch of net section is the greatest working stress to which *solid* steel screwed stays should be subjected. Steel stays which have been welded or worked in the fire are *not* reliable and should not be used.

Stress on *solid* Steel screwed Stays, which have *not* been welde[d or] worked in the fire, 9000 lbs. per square inch of net section.*

Pressure per square inch.	Area 0·8866 sq. in.	Area 0·9940 sq. in.	Area 1·1075 sq. in.	Area 1·2272 sq. in.	Area 1·3530 sq. in.	Area 1·4849 sq. in.	Area 1·6230 sq. in.	Area 1·7671 sq. in.
	Diam. $1\frac{1}{16}$ inch.	Diam. $1\frac{1}{8}$ inch.	Diam. $1\frac{3}{16}$ inch.	Diam. $1\frac{1}{4}$ inch.	Diam. $1\frac{5}{16}$ inch.	Diam. $1\frac{3}{8}$ inch.	Diam. $1\frac{7}{16}$ inch.	Diam. $1\frac{1}{2}$ inch.
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
5	...	...	...	...	...	...	...	...
10	797·9	894·6	996·7	...	...	...	...	...
15	531·9	596·4	664·5	736·3	811·8	890·9	973·8	...
20	398·9	447·3	498·3	552·2	608·9	668·2	730·3	795·1
25	319·1	357·8	398·7	441·7	487·0	534·5	584·2	636·1
30	265·9	298·2	332·2	368·1	405·9	445·4	486·9	530·1
35	227·9	255·6	284·7	315·5	347·9	381·8	417·3	454·3
40	199·4	223·6	249·1	276·1	304·4	334·1	365·1	397·5
45	177·3	198·8	221·5	245·4	270·6	296·9	324·6	353·4
50	159·5	178·9	199·3	220·8	243·5	267·2	292·1	318·0
55	145·0	162·6	181·2	200·8	221·4	242·9	265·5	289·1
60	132·9	149·1	166·1	184·0	202·9	222·7	243·4	265·0
65	122·7	137·6	153·3	169·9	187·3	205·6	224·7	244·6
70	113·9	127·8	142·3	157·7	173·9	190·9	208·6	227·1
75	106·3	119·2	132·9	147·2	162·3	178·1	194·7	212·0
80	99·7	111·8	124·5	138·0	152·2	167·0	182·5	198·7
85	93·8	105·2	117·2	129·9	143·2	157·2	171·8	187·1
90	88·6	99·4	110·7	122·7	135·3	148·4	162·3	176·7
95	83·9	94·1	104·9	116·2	128·1	140·6	153·7	167·4
100	79·7	89·4	99·6	110·4	121·7	135·6	146·0	159·0
105	75·9	85·2	94·9	105·1	115·9	127·2	139·1	151·4
110	72·5	81·3	90·6	100·4	110·7	121·4	132·7	144·5
115	69·3	77·7	86·6	96·0	105·8	116·2	127·0	138·2
120	66·4	74·5	83·0	92·0	101·4	111·3	121·7	132·5
125	63·8	71·5	79·7	88·3	97·4	106·9	116·8	127·2
130	61·3	68·8	76·6	84·9	93·6	102·8	112·3	122·3
135	59·1	66·2	73·8	81·8	90·2	98·9	108·2	117·8
140	56·9	63·9	71·1	78·8	86·9	95·4	104·3	113·5
145	55·0	61·6	68·7	76·1	83·9	92·1	100·7	109·6
150	50·1	59·6	66·4	73·6	81·1	89·0	97·3	106·0
155	51·4	57·7	64·3	71·2	78·5	86·2	94·2	102·6
160	49·8	55·9	62·2	69·0	76·1	83·5	91·2	99·3

* *9000* lbs. per square inch of net section is the greatest working str[ess to] *which solid* steel screwed stays should be subjected. Steel stays which [have] *been welded or worked in the fire* are not reliable, and should not be use[d]

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

TABLE No. 112.

n *Solid* Steel Screwed Stays, which have *not* been welded or
ked in the fire, 9000 lbs. per square inch of net section.*

a 39 ns.	Area 2·2365 sq. ins.	Area 2·4053 sq. ins.	Area 2·5802 sq. ins.	Area 2·7612 sq. ins.	Area 2·9483 sq. ins.	Area 3·1416 sq. ins.	Area 3·3410 sq. ins.	Area 3·5466 sq. ins.
n. 8 h.	Diam. $1\frac{11}{16}$ inch.	Diam. $1\frac{3}{4}$ inch.	Diam. $1\frac{13}{16}$ inch.	Diam. $1\frac{7}{8}$ inch.	Diam. $1\frac{15}{16}$ inch.	Diam. 2 inches.	Diam. $2\frac{1}{16}$ inches.	Diam. $2\frac{1}{8}$ inches.
ace ns.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
·2	...	...	...	...	...	...	...	...
·6	805·1	865·9	928·8	994·0	...	...	...	...
·1	670·9	721·5	774·0	828·3	884·4	942·4	...	...
·2	575·1	618·5	663·4	710·0	758·1	807·8	859·1	911·9
·6	503·2	541·1	580·5	621·2	663·3	706·8	751·7	797·9
·7	447·3	481·0	516·0	552·2	589·6	628·3	668·2	709·3
·3	402·5	432·9	464·4	497·0	530·6	565·4	601·3	638·3
·3	365·9	393·5	422·2	451·8	482·4	514·0	546·7	580·3
·0	335·4	360·7	387·0	414·1	442·2	471·2	501·1	531·9
·1	309·6	333·0	357·2	382·3	408·2	434·9	462·6	491·0
·6	287·5	309·2	331·7	355·0	379·0	403·9	429·5	455·9
·8	268·3	288·6	309·6	331·3	353·7	376·9	400·9	425·5
·3	251·6	270·5	290·2	310·6	331·6	353·4	375·8	398·9
·5	236·8	254·6	273·1	292·3	312·1	332·6	353·7	375·5
·3	223·6	240·5	258·0	276·1	294·8	314·1	334·1	354·6
·4	211·8	227·8	244·4	261·5	279·3	297·6	316·5	335·9
·6	201·2	216·4	232·2	248·5	265·3	282·7	300·6	319·1
·7	191·7	206·1	221·1	236·6	252·7	269·2	286·3	303·9
·6	182·9	196·7	211·0	225·9	241·2	257·0	273·3	290·1
·3	175·0	188·2	201·9	216·0	230·7	245·8	261·4	277·5
·5	167·7	180·3	193·5	207·0	221·1	235·6	250·5	265·9
·3	161·0	173·1	185·7	198·8	212·2	226·1	240·5	255·3
·5	154·8	166·5	178·6	191·1	204·1	217·4	231·3	245·5
·2	149·1	160·3	172·0	184·0	196·5	209·4	222·7	236·4
·3	143·7	154·6	165·8	177·5	189·5	201·9	214·7	227·9
·7	138·8	149·2	160·1	171·3	182·9	194·9	207·3	220·1
·4	134·1	144·3	154·8	165·6	176·8	188·4	200·4	212·7
·4	129·8	139·6	149·8	160·3	171·1	182·4	193·9	205·9
·6	125·8	135·2	145·1	155·3	165·8	176·7	187·9	199·4

bs. per square inch of net section is the greatest working stress to
d steel screwed stays should be subjected. Steel stays which have
ed *or worked in the fire* are *not* reliable and should not be used.

Stress on *Solid* Steel Screwed Stays, which have *not* been welded [or] worked in the fire, 9000 lbs. per square inch of net section.*

Pressure per square inch.	Area 3·7583 sq. ins.	Area 3·9761 sq. ins.	Area 4·2000 sq. ins.	Area 4·4301 sq. ins.	Area 4·6664 sq. ins.	Area 4·9087 sq. ins.	Area 5·1572 sq. ins.	Area 5·4119 sq. ins.	A 5· sq
	Diam. $2\frac{3}{16}$ inches.	Diam. $2\frac{1}{4}$ inches.	Diam. $2\frac{5}{16}$ inches.	Diam. $2\frac{3}{8}$ inches.	Diam. $2\frac{7}{16}$ inches.	Diam. $2\frac{1}{2}$ inches.	Diam. $2\frac{9}{16}$ inches.	Diam. $2\frac{5}{8}$ inches.	D 2 in
lbs.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Su sq
5	...	...	...	...	...	...	...	...	
10	...	...	...	...	...	...	...	...	
15	...	...	...	...	...	...	...	...	
20	...	...	...	...	...	...	...	...	
25	...	...	...	...	...	...	...	...	
30	...	...	...	...	...	...	...	...	
35	966·4	...	...	...	...	...	...	...	
40	845·6	894·6	945·0	996·7	...	...	...	...	
45	751·6	795·2	840·0	886·0	933·2	981·7	...	...	
50	676·4	715·6	756·0	797·4	839·9	883·5	928·2	974·1	
55	614·9	650·6	687·2	724·9	763·5	803·2	843·9	885·5	9
60	563·7	596·4	630·0	664·5	699·9	736·3	773·5	811·7	8
65	520·3	550·5	581·5	613·4	646·1	679·6	714·0	749·3	7
70	483·2	511·2	540·0	569·5	599·9	631·1	663·0	695·8	7
75	450·9	477·1	504·0	531·6	559·9	589·0	618·8	649·4	6
80	422·8	447·3	472·5	498·3	524·9	552·2	580·1	608·8	6
85	397·9	420·9	444·7	469·0	494·0	519·7	546·0	573·0	6
90	375·8	397·6	420·0	443·0	466·6	490·8	515·7	541·1	5
95	356·0	376·6	397·9	419·7	442·0	465·0	488·5	512·7	5
100	338·2	357·8	378·0	398·7	419·9	441·7	464·1	487·0	5
105	322·1	340·8	360·0	379·7	399·9	420·7	442·0	463·8	4
110	307·4	325·3	343·6	362·4	381·7	401·6	421·9	442·7	4
115	294·1	311·1	328·7	346·7	365·1	384·1	403·6	423·5	4
120	281·8	298·2	315·0	332·2	349·9	368·1	386·7	405·8	4
125	270·5	286·2	302·4	318·9	335·9	353·4	371·3	389·6	4
130	260·1	275·2	290·7	306·7	323·0	339·8	357·0	374·6	3
135	250·5	265·0	280·0	295·3	311·0	327·2	343·8	360·7	3
140	241·6	255·6	270·0	284·7	299·9	315·5	331·5	347·9	3
145	233·2	246·7	260·6	274·9	289·6	304·6	320·1	335·9	3
150	225·4	238·5	252·0	265·8	279·9	294·5	309·4	324·7	3
155	218·2	230·8	243·8	257·2	270·9	285·0	299·4	314·2	3
160	211·3	223·6	236·2	249·1	262·4	276·1	290·0	304·4	3

* 9000 lbs. per square inch of net section is the greatest working stre[ss to] which *solid* steel screwed stays should be subjected. Steel stays which [have] been welded or worked in the fire are not reliable and should not be used.

PRESSURES, GREATEST SURFACES, AND SIZES OF STAYS.

TABLE No. 114.

n *Solid* Steel Screwed Stays, which have *not* been welded or ked in the fire, 9000 lbs. per square inch of net section.*

s 96 ns.	Area 6·2126 sq. ins.	Area 6·4918 sq. ins.	Area 6·7771 sq. ins.	Area 7·0686 sq. ins.	Area 7·3662 sq. ins.	Area 7·6699 sq. ins.	Area 7·9798 sq. ins.	Area 8·2958 sq. ins.
n. 4 es.	Diam. $2\frac{13}{16}$ inches.	Diam. $2\frac{7}{8}$ inches.	Diam. $2\frac{15}{16}$ inches.	Diam. 3 inches.	Diam. $3\frac{1}{16}$ inches.	Diam. $3\frac{1}{8}$ inches.	Diam. $3\frac{3}{16}$ inches.	Diam. $3\frac{1}{4}$ inches.
ace ns.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.	Surface sq. ins.
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...	...
·9	...	...	...	...	...	...	...	...
·9	931·8	973·7	...	...	...	...	...	...
·4	860·2	898·8	938·3	978·7	...	...	...	...
·6	798·7	834·6	871·3	908·8	947·0	986·1	...	...
·7	745·5	779·0	813·2	848·2	883·9	920·3	957·5	995·4
·2	698·9	730·3	762·4	795·2	828·6	862·8	897·7	933·2
·8	657·8	687·3	717·5	748·4	779·9	812·1	844·9	878·3
·9	621·2	649·1	677·7	706·8	736·6	766·9	797·9	829·5
·6	588·5	615·0	642·0	669·6	697·8	726·6	755·9	785·9
·5	559·1	584·2	609·9	636·1	662·9	690·2	718·1	746·6
·1	532·5	556·4	580·9	605·8	631·3	657·4	683·9	711·0
·9	508·3	531·1	554·4	578·3	602·6	627·5	652·8	678·7
·8	486·2	508·0	530·3	553·1	576·4	600·2	624·5	649·2
·4	465·9	486·8	508·2	530·1	552·4	575·2	598·4	622·1
·6	447·3	467·4	487·9	508·9	530·3	552·2	574·5	597·2
·2	430·1	449·4	469·1	489·3	509·9	530·9	552·4	574·3
·9	414·1	432·7	451·8	471·2	491·0	511·3	531·9	553·0
·8	399·3	417·3	435·6	454·4	473·5	493·0	512·9	533·3
·6	385·6	402·9	420·6	438·7	457·2	476·0	495·2	514·9
·3	372·7	389·5	406·6	424·1	441·9	460·1	478·7	497·7
·8	360·7	376·9	393·5	410·4	427·7	445·3	463·3	481·6
·0	349·4	365·1	381·2	397·6	414·3	431·4	448·8	466·6

s. per square inch of net section is the greatest working stress to d steel *screwed stays should* be subjected. Steel stays which have *d or worked in the fire* are *not* reliable and should not be used.

STEEL GIRDERS FOR FLAT SURFACES.

The following notes will facilitate the use of the Tables, numbered from 115 to 125, which immediately follow :—

W = Width of combustion box, in inches.
D = Distance between centres of girders, in inches.
P = Pitch of supporting bolts, in inches.
N = Number of supporting bolts in a girder.

When the number of supporting bolts in a girder is *odd*, the number in the table under the particular depth of girder is the maximum value that $W^2 \times D$ may have for the particular working pressure opposite to it in column 1.

When the number of supporting bolts in a girder is *even*, the number in the table under the particular depth of girder is the maximum value that $(W^2 - P^2)D$ may have for the particular working pressure opposite to it in column 1.

(1) If the working pressure is required when the width of the box, the distance between centres of girders, the pitch of supporting bolts, the number of supporting bolts in the girder, and the dimensions of girder are known.

If the width, W, of the combustion box be 28 inches, the number, N, of the bolts 3 (which is an *odd* number), the distance, D, between the centres of the girders 7 inches, and the dimensions of the girder 6 inches deep by 1 inch thick :—

Then, $W^2 \times D$ or $28^2 \times 7 = 5488$. This number is not found in the table, as it is between 5280 and 5590 (see Table No. 119 for steel plates 1 inch thick), but by the note at the foot of the tables when the exact number is not found, the next *higher* number should be taken, and the pressure opposite 5590, the next *higher* number being 85 lbs., is the working pressure obtained; although, should the difference be very little over the lower number, such lower number may be used, and the pressure opposite it taken.

(2) When the depth of girder necessary for a given working pressure and thickness of girder is required :—

If the width, W, of the combustion box be 24 inches, the number, N, of supporting bolts 2 (which is an *even* number), the distance, D, between the centres of the girders 8¾ inches, the pitch of the supporting bolts 8 inches, the thickness of the girders 1 inch, and the working pressure 80 lbs. :—

Then, $(W^2 - P^2)D$ or $(24^2 - 8^2)8\frac{3}{4} = 4480$, and opposite 80 lbs. the working pressure in column 1, the number 4547 is found (see Table No. 119 for steel plates 1 inch thick), which is the next *greater* number to 4480, and at the head of column over 4547 will be found 5¼ inches, the depth of girder necessary.

n all cases be found by dividing W, the width of the com-
ɔx, by N, the number of supporting bolts in the girder,

$$\frac{W}{N+1} = P \text{ in all cases.}$$

ι the number of supporting bolts is *odd*, may be found by
he number in the table opposite the given working pressure

he number of supporting bolts is *even*, D can be found by
ıe number in the table opposite the given working pressure
ı.

king pressure and thickness of plate regulate P, the pitch,
ı distance between the centres of girders and the surface due
should be regulated by the Tables for Steel Plates (Pitches,
nd Pressures). The girders should be proportioned so as to
e for the pressure, pitch of supporting bolts, number of
; bolts in a girder, and the distance between the centres of
By the following tables the dimensions of steel girders can
r the working pressure suitable for any given mild rolled
girder ascertained.

Pressure per sq. in.	Depths of Girders in inches.								
	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾
lbs.									
5	4042	5280	6682	8250	9982	11880	13942	16170	18562
10	2021	2640	3341	4125	4991	5940	6971	8085	9281
15	1347	1760	2227	2750	3327	3960	4647	5390	6187
20	1010	1320	1670	2062	2495	2970	3485	4042	4640
25	808	1056	1336	1650	1996	2376	2788	3234	3712
30	673	880	1113	1375	1663	1980	2323	2695	3093
35	577	754	954	1178	1426	1697	1991	2310	2651
40	505	660	835	1031	1247	1485	1742	2021	2320
45	...	586	742	916	1109	1320	1549	1796	2062
50	...	528	668	825	998	1188	1394	1617	1856
55	...	...	607	750	907	1080	1267	1470	1687
60	...	...	556	687	831	990	1161	1347	1546
65	...	...	514	634	767	913	1072	1243	1427
70	...	...	...	589	713	848	995	1155	1325
75	...	...	...	550	665	792	929	1078	1237
80	...	...	...	515	623	742	871	1010	1160
85	...	...	...	...	587	698	820	951	1091
90	...	...	...	...	554	660	774	898	1031
95	...	...	...	...	525	625	733	851	976
100	...	...	...	...	...	594	697	808	928
105	...	...	...	...	...	565	663	770	883
110	...	...	...	...	...	540	633	735	843
115	...	...	...	...	...	516	606	703	807
120	...	...	...	...	...	...	580	673	773
125	...	...	...	...	...	...	557	646	742
130	...	...	...	...	...	...	536	621	713
135	...	...	...	...	...	...	516	598	687
140	...	...	...	...	...	...	...	577	662
145	...	...	...	...	...	...	...	557	640
150	...	...	...	...	...	...	...	539	618
155	...	...	...	...	...	...	...	521	598
160	...	...	...	...	...	...	...	505	580

In the above Table, when the number of supporting bolts in a girder is *odd*, the number under the particular depth of girder equals W^2D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. When the exact value or number is not found under the given depth, the next greater number in the same column is the number, opposite which will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = *Pitch* of supporting bolts in inches.

STEEL GIRDERS ⅝ INCH THICK. TABLE No. 116.

s.	Depths of Girders in inches.								
	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼
5	8353	10312	12478	14850	17428	20212	23203	26400	29803
0	4176	5156	6239	7425	8714	10106	11601	13200	14901
5	2784	3437	4159	4950	5809	6737	7734	8800	9934
0	2088	2578	3119	3712	4357	5053	5800	6600	7450
5	1670	2062	2495	2970	3485	4042	4640	5280	5960
0	1392	1718	2079	2475	2904	3368	3867	4400	4967
5	1193	1473	1782	2121	2489	2887	3314	3771	4257
0	1044	1289	1559	1856	2178	2526	2900	3300	3725
5	928	1145	1386	1650	1936	2245	2578	2933	3311
0	835	1031	1247	1485	1742	2021	2320	2640	2980
5	759	937	1134	1350	1584	1837	2109	2400	2709
0	696	859	1039	1237	1452	1684	1933	2200	2483
5	642	793	959	1142	1340	1554	1784	2030	2292
0	596	736	891	1060	1244	1443	1657	1885	2128
5	556	687	831	990	1161	1347	1546	1760	1986
0	522	644	779	928	1089	1263	1450	1650	1862
5	...	606	734	873	1025	1188	1364	1552	1753
0	...	572	693	825	968	1122	1289	1466	1655
5	...	542	656	781	917	1063	1221	1389	1568
0	...	515	623	742	871	1010	1160	1320	1490
5	...	...	594	707	829	962	1104	1257	1419
0	...	...	567	675	792	918	1054	1200	1354
5	...	...	542	645	757	878	1008	1147	1295
0	...	...	519	618	726	842	966	1100	1241
5	...	...	...	594	697	808	928	1056	1192
0	...	...	...	571	670	777	892	1015	1146
5	...	...	...	550	645	748	859	977	1103
0	...	...	...	530	622	721	828	942	1064
5	...	...	...	512	600	696	800	910	1027
0	...	...	...	...	580	673	773	880	993
5	...	...	...	...	562	652	748	851	961
0	...	...	...	...	544	631	725	825	931

In the above Table, when the number of supporting bolts in a der is *odd*, the number under the particular depth of girder equals ²D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. hen the exact value or number is not found under the given depth, next greater number in the same column is the number, opposite ich will be found the working pressure in column 1.

W = Width of combustion box in inches.

D = Distance between centres of girders in inches.

P = Pitch of supporting bolts in inches.

Pressure per sq. in.	Depths of Girders in inches.							
	2¾	3	3¼	3½	3¾	4	4¼	4½
lbs. 5	14973	17820	20913	24255	27843	31680	35763	40095
10	7486	8910	10456	12127	13921	15840	17881	20047
15	4991	5940	6971	8085	9281	10560	11921	13365
20	3743	4455	5228	6063	6960	7920	8940	10023
25	2994	3564	4182	4851	5568	6336	7152	8019
30	2495	2970	3485	4042	4640	5280	5960	6682
35	2139	2545	2987	3465	3977	4525	5109	5727
40	1871	2227	2614	3031	3480	3960	4470	5011
45	1663	1980	2323	2695	3093	3520	3973	4455
50	1497	1782	2091	2425	2784	3168	3576	4009
55	1361	1620	1901	2205	2531	2880	3251	3645
60	1247	1485	1742	2021	2320	2640	2980	3341
65	1151	1370	1608	1865	2141	2436	2751	3084
70	1069	1272	1493	1732	1988	2262	2554	2863
75	998	1188	1394	1617	1856	2112	2384	2673
80	935	1113	1307	1515	1740	1980	2235	2505
85	880	1048	1230	1426	1637	1863	2103	2358
90	831	990	1161	1347	1546	1760	1986	2227
95	788	937	1100	1276	1465	1667	1882	2110
100	748	891	1045	1212	1392	1584	1788	2004
105	713	848	995	1155	1325	1508	1703	1909
110	680	810	950	1102	1265	1440	1625	1822
115	651	774	909	1054	1210	1377	1554	1743
120	623	742	871	1010	1160	1320	1490	1670
125	598	712	836	970	1113	1267	1430	1603
130	575	685	804	932	1070	1218	1375	1542
135	554	660	774	898	1031	1173	1324	1485
140	534	636	746	866	994	1131	1277	1431
145	516	614	721	836	960	1092	1233	1382
150	...	594	697	808	928	1056	1192	1336
155	...	574	674	782	898	1021	1153	1293
160	...	556	653	757	870	990	1117	1252

In the above Table, when the number of supporting bolt girder is *odd*, the number under the particular depth of girder W^2D; but when the number of bolts is *even*, it equals (W^2 – When the exact value or number is not found under the given the next greater number in the same column is the number, o which will be found the working pressure in column 1.

W = Width of combustion box in inches.

D = Distance between centres of girders in inches.

P = Pitch of supporting bolts in inches.

Depths of Girders in inches.

3½	3¾	4	4¼	4½	4¾	5	5¼	5½
8297	32484	36960	41724	46777	...	...	...	...
4148	16242	18480	20862	23388	26059	28875	31834	34938
9432	10828	12320	13908	15592	17373	19250	21223	23292
7074	8121	9240	10431	11694	13029	14437	15917	17469
5659	6496	7392	8344	9355	10423	11550	12733	13975
4716	5414	6160	6954	7796	8686	9625	10611	11646
4042	4640	5280	5960	6682	7445	8250	9095	9982
3537	4060	4620	5215	5847	6514	7218	7958	8734
3144	3609	4106	4636	5197	5791	6416	7074	7764
2829	3248	3696	4172	4677	5211	5775	6366	6987
2572	2953	3360	3793	4252	4738	5250	5788	6352
2358	2707	3080	3477	3898	4343	4812	5305	5823
2176	2498	2843	3209	3598	4009	4442	4897	5375
2021	2320	2640	2980	3341	3722	4125	4547	4991
1886	2165	2464	2781	3118	3474	3850	4244	4658
1768	2030	2310	2607	2923	3257	3609	3979	4367
1664	1910	2174	2454	2751	3065	3397	3745	4110
1572	1804	2053	2318	2598	2895	3208	3537	3882
1489	1709	1945	2196	2461	2743	3039	3351	3677
1414	1624	1848	2086	2338	2605	2887	3183	3493
1347	1546	1760	1986	2227	2481	2750	3031	3327
1286	1476	1680	1896	2126	2369	2625	2894	3176
1230	1412	1606	1814	2033	2266	2510	2768	3038
1179	1353	1540	1738	1949	2171	2406	2652	2911
1131	1299	1478	1668	1871	2084	2310	2546	2795
1088	1249	1421	1604	1799	2004	2221	2448	2687
1048	1203	1368	1545	1732	1930	2138	2358	2588
1010	1160	1320	1490	1670	1861	2062	2273	2495
975	1120	1274	1438	1613	1797	1991	2195	2409
943	1082	1232	1390	1559	1737	1925	2122	2329
912	1047	1192	1345	1508	1681	1862	2053	2254
884	1015	1155	1303	1461	1628	1804	1989	2183

the above Table, when the number of supporting bolts in a is *odd*, the number under the particular depth of girder equals but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. the exact value or number is not found under the given depth, ext greater number in the same column is the number, opposite will be found the working pressure in column 1.

W = Width of combustion box in inches.

D = Distance between centres of girders in inches.

P = *Pitch of supporting* bolts in inches.

Pressure per sq. in.	Depths of Girders in inches.								
	4¼	4½	4¾	5	5¼	5½	5¾	6	6¼
lbs.									
5	47685	...	...	...	...	...	...	...	...
10	23842	26730	29782	33000	36382	39930	43642	47520	...
15	15895	17820	19855	22000	24255	26620	29095	31680	34375
20	11921	13365	14891	16500	18191	19965	21821	23760	25781
25	9537	10692	11913	13200	14553	15972	17457	19008	20625
30	7947	8910	9927	11000	12127	13310	14547	15840	17187
35	6812	7637	8509	9428	10395	11408	12469	13577	14732
40	5960	6682	7445	8250	9095	9982	10910	11880	12890
45	5298	5940	6618	7333	8085	8873	9698	10560	11458
50	4768	5346	5956	6600	7276	7986	8728	9504	10312
55	4335	4860	5415	6000	6615	7260	7935	8640	9374
60	3973	4455	4963	5500	6063	6655	7273	7920	8593
65	3668	4112	4581	5076	5597	6143	6714	7310	7932
70	3406	3818	4254	4714	5197	5704	6234	6788	7366
75	3179	3564	3971	4400	4851	5324	5819	6336	6875
80	2980	3341	3722	4125	4547	4991	5455	5940	6445
85	2805	3144	3503	3882	4280	4697	5134	5590	6066
90	2649	2970	3309	3666	4042	4436	4849	5280	5729
95	2509	2813	3135	3473	3829	4203	4593	5002	5427
100	2384	2673	2978	3300	3638	3993	4364	4752	5156
105	2270	2545	2836	3142	3465	3802	4156	4525	4910
110	2167	2430	2707	3000	3307	3630	3967	4320	4687
115	2073	2324	2589	2869	3163	3472	3795	4132	4483
120	1986	2227	2481	2750	3031	3327	3636	3960	4296
125	1907	2138	2382	2640	2910	3194	3491	3801	4125
130	1834	2056	2290	2538	2798	3071	3357	3655	3966
135	1766	1980	2206	2444	2695	2957	3232	3520	3819
140	1703	1909	2127	2357	2598	2852	3117	3394	3683
145	1644	1843	2053	2275	2509	2753	3009	3277	3556
150	1589	1782	1985	2200	2425	2662	2909	3168	3437
155	1538	1724	1921	2129	2347	2576	2815	3065	3326
160	1490	1670	1861	2062	2273	2495	2727	2970	3222

In the above Table, when the number of supporting bolts in a girder is *odd*, the number under the particular depth of girder equals W^2D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. When the exact value or number is not found under the given depth, the next greater number in the same column is the number, opposite which will be found the working pressure in column 1.

W = Width of combustion box in inches.

D = Distance between centres of girders in inches.

P = Pitch of supporting bolts in inches.

per sq. in.	Depths of Girders in inches.								
	5	5¼	5½	5¾	6	6¼	6½	6¾	7
5	...	...	...	...	...	...	...	...	...
10	37125	40930	44921	49097	...	...	...	...	...
15	24750	27286	29947	32731	35640	38671	41827	45106	48510
20	18562	20465	22460	24548	26730	29003	31370	33830	36382
25	14850	16372	17968	19639	21384	23203	25096	27064	29106
30	12375	13643	14973	16365	17820	19335	20913	22553	24255
35	10607	11694	12834	14027	15274	16573	17926	19331	20790
40	9281	10232	11230	12274	13365	14501	15685	16915	18191
45	8250	9095	9982	10910	11880	12890	13942	15035	16170
50	7425	8186	8984	9819	10692	11601	12548	13532	14553
55	6750	7441	8167	8926	9720	10546	11407	12301	13230
60	6187	6821	7486	8182	8910	9667	10456	11276	12127
65	5711	6296	6910	7553	8224	8924	9652	10409	11194
70	5303	5847	6417	7013	7637	8286	8963	9665	10395
75	4950	5457	5989	6546	7128	7734	8365	9021	9702
80	4640	5116	5615	6137	6682	7250	7842	8457	9095
85	4367	4815	5284	5776	6289	6824	7381	7960	8560
90	4125	4547	4991	5455	5940	6445	6971	7517	8085
95	3907	4308	4728	5168	5627	6106	6604	7122	7659
00	3712	4093	4492	4909	5346	5800	6274	6766	7276
05	3535	3898	4278	4675	5091	5524	5975	6443	6930
10	3375	3720	4083	4463	4860	5273	5703	6150	6615
15	3228	3559	3906	4269	4648	5044	5455	5883	6327
20	3093	3410	3743	4091	4455	4833	5228	5638	6063
25	2970	3274	3593	3927	4276	4640	5019	5412	5821
30	2855	3148	3455	3776	4112	4462	4826	5204	5597
35	2750	3031	3327	3636	3960	4296	4647	5011	5390
40	2651	2923	3208	3506	3818	4143	4481	4832	5197
45	2560	2822	3098	3386	3686	4000	4326	4666	5018
50	2475	2728	2994	3273	3564	3867	4182	4510	4851
55	2395	2640	2898	3167	3449	3742	4047	4365	4694
60	2320	2558	2807	3068	3341	3625	3921	4228	4547

In the above Table, when the number of supporting bolts in a rder is *odd*, the number under the particular depth of girder equals ^{2}D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. hen the exact value or number is not found under the given depth, e next greater number in the same column is the number, opposite hich will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = Pitch of supporting bolts in inches.

Pressure per sq. in.	Depths of Girders in inches.							
	5¾	6	6¼	6½	6¾	7	7¼	7½
lbs. 5	...	...	...	...	...	...	...	...
10	54553	...	...	...	...	...	...	...
15	36368	39600	42968	46475	...	...	...	...
20	27276	29700	32226	34856	37589	40425	43364	46406
25	21821	23760	25781	27885	30071	32340	34691	37125
30	18184	19800	21484	23237	25059	26950	28909	30937
35	15586	16971	18415	19917	21479	23100	24779	26517
40	13638	14850	16113	17428	18794	20212	21682	23203
45	12122	13200	14322	15491	16706	17966	19272	20625
50	10910	11880	12890	13942	15035	16170	17345	18562
55	9918	10800	11718	12675	13668	14700	15768	16875
60	9092	9900	10742	11618	12529	13475	14454	15468
65	8392	9138	9915	10725	11565	12438	13342	14278
70	7793	8485	9207	9958	10739	11550	12389	13258
75	7273	7920	8593	9295	10023	10780	11563	12375
80	6819	7425	8056	8714	9397	10106	10841	11601
85	6418	6988	7582	8201	8844	9511	10203	10919
90	6061	6600	7161	7745	8353	8983	9636	10312
95	5742	6252	6784	7338	7913	8510	9129	9769
100	5455	5940	6445	6971	7517	8085	8672	9281
105	5195	5657	6138	6639	7159	7700	8259	8839
110	4959	5400	5859	6337	6834	7350	7884	8437
115	4743	5165	5604	6061	6537	7030	7541	8070
120	4546	4950	5371	5809	6264	6737	7227	7734
125	4364	4752	5156	5577	6014	6468	6938	7425
130	4196	4569	4957	5362	5782	6219	6671	7139
135	4040	4400	4774	5163	5568	5988	6424	6875
140	3896	4242	4603	4979	5369	5775	6194	6629
145	3762	4096	4445	4807	5184	5575	5981	6400
150	3636	3960	4296	4647	5011	5390	5781	6187
155	3519	3832	4158	4497	4850	5216	5595	5987
160	3409	3712	4028	4357	4698	5053	5420	5800

In the above Table, when the number of supporting bolts [illegible] girder is *odd*, the number under the particular depth of girder eq[illegible] W^2D; but when the number of bolts is *even*, it equals $(W^2-P^2$[illegible] When the exact value or number is not found under the given dep[illegible] the next greater number in the same column is the number, oppo[illegible] which will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = Pitch of supporting bolts in inches.

Depths of Girders in inches.								
6½	6¾	7	7¼	7½	7¾	8	8¼	8½
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
38341	41347	44467	47700	...	...	...	...	...
30673	33078	35574	38160	40837	43605	46464	49413	...
25561	27565	29645	31800	34031	36337	38720	41177	43711
21909	23627	25410	27257	29169	31146	33188	35295	37466
19170	20673	22233	23850	25523	27253	29040	30883	32783
17040	18376	19763	21200	22687	24225	25813	27451	29140
15336	16539	17787	19080	20418	21802	23232	24706	26226
13942	15035	16170	17345	18562	19820	21120	22460	23842
12780	13782	14822	15900	17015	18168	19360	20588	21855
11797	12722	13682	14677	15706	16771	17870	19005	20174
10954	11813	12705	13628	14584	15573	16594	17647	18733
10224	11026	11858	12720	13612	14535	15488	16471	17484
9585	10336	11116	11925	12761	13626	14520	15441	16391
9021	9728	10462	11223	12011	12825	13665	14533	15427
8520	9188	9881	10600	11343	12112	12906	13725	14570
8071	8704	9361	10042	10746	11475	12227	13003	13803
7668	8269	8893	9540	10209	10901	11616	12353	13113
7303	7875	8470	9085	9723	10382	11062	11765	12488
6971	7517	8085	8672	9281	9910	10560	11230	11921
6668	7190	7733	8295	8877	9479	10100	10742	11402
6390	6891	7411	7950	8507	9084	9680	10294	10927
6134	6615	7114	7632	8167	8721	9292	9882	10490
5898	6361	6841	7338	7853	8385	8935	9502	10087
5680	6125	6587	7066	7562	8075	8604	9150	9713
5477	5906	6352	6814	7292	7786	8297	8823	9366
5288	5703	6133	6579	7040	7518	8011	8519	9043
5112	5513	5929	6360	6806	7267	7744	8235	8742
4947	5335	5737	6154	6586	7033	7494	7969	8460
4792	5168	5558	5962	6380	6813	7260	7720	8195

ı the above Table, when the number of supporting bolts in a er is *odd*, the number under the particular depth of girder equals); but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. en the exact value or number is not found under the given depth, next greater number in the same column is the number, opposite ch will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = *Pitch of supporting bolts in inches.*

Pressure per sq. in.	Depths of Girders in inches.								
	7¼	7½	7¾	8	8¼	8½	8¾	9	9¼
lbs.									
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	41629	44550	47569	...	...	...	...	...	...
30	34691	37125	39641	42240	44921	47685	...	...	...
35	29735	31821	33978	36205	38503	40872	43312	45822	48403
40	26018	27843	29730	31680	33690	35763	37898	40095	42353
45	23127	24750	26427	28160	29947	31790	33687	35640	37647
50	20814	22275	23784	25344	26952	28611	30318	32076	33882
55	18922	20250	21622	23040	24502	26010	27562	29160	30802
60	17345	18562	19820	21120	22460	23842	25265	26730	28235
65	16011	17134	18295	19495	20732	22008	23322	24673	26063
70	14867	15910	16989	18102	19251	20436	21656	22911	24201
75	13876	14850	15856	16896	17968	19074	20212	21384	22588
80	13009	13921	14865	15840	16845	17881	18949	20047	21176
85	12243	13102	13991	14908	15854	16830	17834	18868	19931
90	11563	12375	13213	14080	14973	15895	16843	17820	18823
95	10955	11723	12518	13338	14185	15058	15957	16882	17833
100	10407	11137	11892	12672	13476	14305	15159	16038	16941
105	9911	10607	11326	12068	12834	13624	14437	15274	16134
110	9461	10125	10811	11520	12251	13005	13781	14580	15401
115	9049	9684	10341	11019	11718	12439	13182	13946	14731
120	8672	9281	9910	10560	11230	11921	12632	13365	14117
125	8325	8910	9513	10137	10781	11444	12127	12830	13553
130	8005	8567	9147	9747	10366	11004	11661	12336	13031
135	7709	8250	8809	9386	9982	10596	11229	11880	12549
140	7433	7955	8494	9051	9625	10218	10828	11455	12100
145	7177	7681	8201	8739	9294	9865	10454	11060	11683
150	6938	7425	7928	8448	8984	9537	10106	10692	11294
155	6714	7185	7672	8175	8694	9229	9780	10347	10929
160	6504	6960	7432	7920	8422	8940	9474	10023	10588

In the above Table, when the number of supporting bolts in a girder is *odd*, the number under the particular depth of girder equals W^2D; but when the number of bolts is *even*, it equals $(W^2-P^2)D$. When the exact value or number is not found under the given depth, the next greater number in the same column is the number, opposite which will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = Pitch of supporting bolts in inches.

STEEL GIRDERS 1⅝ INCH THICK. TABLE No. 124.

Depths of Girders in inches.								
8	8¼	8½	8¾	9	9¼	9½	9¾	10
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
45760	48664	...	...	...	...	...	...	...
39222	41712	44278	46921	49641	...	...	...	...
34320	36498	38744	41056	43436	45882	48396	...	...
30506	32443	34439	36494	38610	40784	43019	45313	47666
27456	29198	30995	32845	34749	36706	38717	40781	42900
24960	26544	28177	29859	31590	33369	35197	37074	39000
22880	24332	25829	27371	28957	30588	32264	33984	35750
21120	22460	23842	25265	26730	28235	29782	31370	33000
19611	20856	22139	23460	24820	26218	27655	29129	30642
18304	19465	20663	21896	23166	24470	25811	27187	28600
17160	18249	19372	20528	21718	22941	24198	25488	26812
16150	17175	18232	19320	20440	21591	22774	23989	35235
15253	16221	17219	18247	19305	20392	21509	22656	23833
14450	15367	16313	17287	18288	19319	20377	21464	22578
13728	14599	15497	16422	17374	18353	19358	20390	21450
13074	13904	14759	15640	16547	17479	18436	19419	20428
12480	13272	14088	14929	15795	16684	17598	18537	19500
11937	12695	13476	14280	15108	15959	16833	17731	18652
11440	12166	12914	13685	14478	15294	16132	16992	17875
10982	11679	12398	13138	13899	14682	15486	16312	17160
10560	11230	11921	12632	13365	14117	14891	15685	16500
10168	10814	11479	12164	12870	13594	14339	15104	15888
9805	10428	11069	11730	12410	13109	13827	14564	15321
9467	10068	10688	11325	11982	12657	13350	14062	14793
9152	9732	10331	10948	11583	12235	12905	13593	14300
8856	9418	9998	10595	11209	11840	12489	13155	13838
8580	9124	9686	10264	10859	11470	12099	12744	13406

n the above Table, when the number of supporting bolts in a er is *odd*, the number under the particular depth of girder equals); but when the number of bolts is *even*, it equals $(W^2-P^2)D$. en the exact value or number is not found under the given depth, next greater number in the same column is the number, opposite ch will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = Pitch of supporting bolts in inches.

Pressure per sq. in.	Depths of Girders in inches.								
	8¾	9	9¼	9½	9¾	10	10¼	10½	10¾
lbs.									
5	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...
40	44214	46777	49412	...	...	...	...	...	...
45	39302	41580	43922	46328	48798	...	...	...	...
50	35371	37422	39529	41695	43918	46200	48538	...	...
55	32156	34020	35936	37905	39926	42000	44126	46305	48536
60	29476	31185	32941	34746	36599	38500	40449	42446	44491
65	27209	28786	30407	32073	33783	35538	37337	39181	41069
70	25265	26730	28235	29782	31370	33000	34670	36382	38135
75	23581	24948	26353	27797	29279	30800	32359	33957	35593
80	22107	23388	24706	26059	27449	28875	30336	31834	33368
85	20806	22012	23252	24526	25834	27176	28552	29962	31405
90	19651	20790	21961	23164	24399	25666	26966	28297	29661
95	18616	19695	20805	21945	23115	24315	25546	26808	28099
100	17685	18711	19764	20847	21959	23100	24269	25467	26694
105	16843	17820	18823	19855	20913	22000	23113	24255	25423
110	16078	17010	17968	18952	19963	21000	22063	23152	24268
115	15379	16270	17186	18128	19095	20086	21103	22145	23212
120	14738	15592	16470	17373	18299	19250	20224	21223	22245
125	14148	14968	15811	16678	17567	18480	19415	20374	21355
130	13604	14393	15203	16036	16891	17769	18668	19590	20534
135	13100	13860	14640	15442	16266	17111	17977	18865	19774
140	12632	13365	14117	14891	15685	16500	17335	18191	19067
145	12197	12904	13630	14377	15144	15931	16737	17563	18410
150	11790	12474	13176	13898	14639	15400	16179	16978	17796
155	11410	12071	12751	13450	14167	14903	15657	16430	17222
160	11053	11694	12353	13029	13724	14437	15168	15917	16684

In the above Table, when the number of supporting bolts in a girder is *odd*, the number under the particular depth of girder equals W^2D; but when the number of bolts is *even*, it equals $(W^2 - P^2)D$. When the exact value or number is not found under the given depth, the next greater number in the same column is the number, opposite which will be found the working pressure in column 1.

W = Width of combustion box in inches.
D = Distance between centres of girders in inches.
P = Pitch of supporting bolts in inches.

CYLINDRICAL BOILER SHELLS.

Steel Plates from ¼ inch to 1⅜ inch thick.

Numerals and *Nominal* Factors from 5 to 6·9.

e use of the Tables Nos. 126 to 139, which immediately follow marks, the working pressure can be determined, for any given ss of plate and given diameter, when the calculated percentage of the longitudinal joint is known and *nominal* factor fixed; neter can be determined for a given thickness of plate, when culated percentage of the longitudinal joint is known and etermined; and what the calculated percentage of the longitu-int should be, for a given thickness of plate, a given diameter given working pressure and *nominal* factor; what the thick- the plate should be, when it is known what the diameter, pressure, *nominal* factor, and the calculated percentage of the linal joint are to be; and the *nominal* factor which the boiler ill be, worked at can also be determined, if between 5 and 6·9, he thickness of the plate, the working pressure, diameter, and ed percentage of the longitudinal joints are known.

ables are calculated for tensile strengths of steel plates of 26, 29, 30, 31, and 32 tons per square inch, and they apply equally drical shells, cylindrical steam receivers, or domes of boilers.

ominal factors are given at the top of the column under the F.

numerals in the columns N are those applicable to the thick-hich they are opposite and tensile strength at the head of the nd to the *nominal* factors at the head of the columns in which placed.

= Numeral for the thickness, tensile strength, and *nominal* factor of safety.
= Calculated percentage of joint.
= Diameter of boiler, inside, in inches.
= Working pressure, in lbs., per square inch.
= *Nominal* factor of safety.

$$\frac{N \times \%}{D} = B.$$

$$\frac{N \times \%}{B} = D.$$

$$\frac{D \times B}{N} = \%.$$

$$\frac{D \times B}{\%} = N.$$

(1) If the working pressure has to be found when the plates are 1¼ inch thick, having a tensile strength of 28 tons per square inch, the *nominal* factor being 5, the calculated percentage of the joints 84·95, and the diameter of the boiler 174 inches :—

Then, opposite the thickness of the plate 1¼ inch, in the table for 28 tons, and under F 5, the *nominal* factor, the numeral is 313·6, and if this be multiplied by 84·95, the calculated percentage of the joints, and the product divided by 174, the diameter, the quotient equals the working pressure, or

$$\frac{313 \cdot 6 \times 84 \cdot 95}{174} = 153 \cdot 105 = \text{B},$$

which is the working pressure required to be found, or, say, 155 lbs. per square inch.

If the tensile strength had been 29 tons per square inch, then, in the table for that tensile strength the numeral would be found to be 324·8, or

$$\frac{324 \cdot 8 \times 84 \cdot 95}{174} = 158 \cdot 57 = \text{B},$$

(2) If the thickness of the plates is required to be determined, when the steel is assumed at 28 tons, the diameter of the boiler being 82 inches, the pressure 155 lbs., the *nominal* factor 5, and the calculated percentage of joints 81·49 (see Tables No. 140 to 161 on Riveting, Steel Plates and Steel Rivets) :—

Then, if 82, the diameter, be multiplied by 155, the pressure, and the product divided by 81·49, the calculated percentage of joints, the quotient equals the numeral applicable to the case, which should be looked for under F 5 (in the table for 28 tons steel), the *nominal* factor, and opposite the numeral the thickness required may be found, or

$$\frac{82 \times 155}{81 \cdot 49} = 155 \cdot 97 = \text{N},$$

but the nearest numeral under F 5 is 156·8, and as it differs so little from 155·97 $\left(\text{that found by the formula } \frac{\text{D} \times \text{B}}{\%}\right)$, the thickness opposite N 156·8, and under F 5, is the thickness which practically meets the requirements of the case, viz., ⅝ inch.

(3) If the diameter has to be settled for a working pressure of 160 lbs. at a *nominal* factor 5, the thickness of plates being 1⅜ inch, and the calculated percentage of joints 84·95, and the tensile strength of the plates being 28 tons per square inch :—

Then, under F 5, the factor, and opposite 1⅜ inch, the thickness of the plates, in the table for 28 tons steel, the numeral is 344·96, and if it be multiplied by 84·95, the calculated percentage

of joint, and the product divided by 160, the pressure, the quotient equals what the diameter should be, or

$$\frac{344 \cdot 96 \times 84 \cdot 95}{160} = 183 \cdot 15 = D,$$

or say 15 feet 3 inches.

(4) If the calculated percentage of joints has to be determined when the plates are ½ inch thick, the tensile strength 28 tons, the *nominal* factor 5, the working pressure 100 lbs. and the diameter of the boiler 97 inches:—

Then, if 100, the pressure, be multiplied by 97, the diameter, and the product divided by the numeral, 125·44, found opposite ½ inch, the thickness (in table for 28 tons steel), and under F 5, the *nominal* factor, the quotient equals the calculated percentage of joint, or,

$$\frac{100 \times 97}{125 \cdot 44} = 77 \cdot 32 = \%,$$

but a suitable calculated percentage of joint for such a thickness of plate, when the riveting is as illustrated in Table No. 150, is 77·2, which is practically that arrived at, and may be adopted without materially affecting the result.

The calculated percentage of joints made of steel plates and steel rivets of various descriptions of riveting and of different thickness of plates, is given in Tables No. 140 to 161.

The *nominal* factor can be found by the tables, for each tensile strength of plate given, when, N, the numeral is found (by the formula $\left(\frac{D \times B}{\%}\right)$, for a given thickness, as above the numerals in any one column, the factor under F is the *nominal* factor in the particular case. If the exact numeral is not found opposite any given thickness, within the range of the tables, but a numeral comes between any two numerals, opposite the given thickness, then the *nominal* factor is between the factors at the top of the two columns in which the numerals are found—one slightly under and the other rather higher; therefore, the factor can always be determined within about 1 per cent., although the exact numeral may not be found in the tables.

Thus if the thickness be ½ inch and $\frac{D \times B}{\%} = 125 \cdot 44 = N$, 125·44 is found opposite ½ inch, for 28 tons steel, and at the top of the column the *nominal* factor is 5; but if by the formula the numeral arrived at had been, say, 124, which is a numeral between two numerals given in the tables opposite ½, then the *nominal* factor in such a case would be a little higher than 5, but less than 5·1. If the numeral found by the formula had been 104·53, the *nominal* factor would be 6, as 104·53 is found opposite ½ inch under the column F 6 in table for 28 tons steel.

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 26 tons per square inch.

Numerals and *Nominal* Factors from 5 to 5·9.

Thickness of Plate.	F 5·0	F 5·1	F 5·2	F 5·3	F 5·4	F 5·5	F 5·6	F 5·7	F 5·8	F 5·9
inches.	N	N	N	N	N	N	N	N	N	N
1/4	58·24	57·09	56·0	54·94	53·92	52·94	52·0	51·08	50·20	49·35
9/32	65·52	64·23	63·0	61·81	60·66	59·56	58·5	57·47	56·48	55·52
5/16	72·80	71·37	70·0	68·67	67·40	66·18	65·0	63·85	62·75	61·69
11/32	80·08	78·50	77·0	75·54	74·14	72·80	71·5	70·24	69·03	67·86
3/8	87·36	85·64	84·0	82·41	80·88	79·41	78·0	76·63	75·31	74·03
13/32	94·64	92·78	91·0	89·28	87·62	86·03	84·5	83·01	81·58	80·20
7/16	101·92	99·92	98·0	96·15	94·37	92·65	91·0	89·40	87·86	86·37
15/32	109·20	107·05	105·0	103·01	101·11	99·27	97·5	95·78	94·13	92·54
1/2	116·48	114·19	112·0	109·88	107·85	105·89	104·0	102·17	100·41	98·71
17/32	123·76	121·33	119·0	116·75	114·59	112·50	110·5	108·56	106·68	104·8[illegible]
9/16	131·04	128·47	126·0	123·62	121·33	119·12	117·0	114·94	112·96	111·05
19/32	138·32	135·60	133·0	130·49	128·07	125·74	123·5	121·33	119·24	117·[illegible]
5/8	145·60	142·74	140·0	137·35	134·81	132·36	130·0	127·71	125·51	123·[illegible]
21/32	152·88	149·88	147·0	144·22	141·55	138·98	136·5	134·10	131·79	129·[illegible]
11/16	160·16	157·01	154·0	151·09	148·29	145·60	143·0	140·49	138·06	135·[illegible]
23/32	167·44	164·15	161·0	157·96	155·03	152·21	149·5	146·87	144·34	141·[illegible]
3/4	174·72	171·29	168·0	164·83	161·77	158·83	156·0	153·26	150·62	148·[illegible]
25/32	182·0	178·43	175·0	171·69	168·51	165·45	162·5	159·64	156·89	154·[illegible]
13/16	189·28	185·56	182·0	178·56	175·25	172·07	169·0	166·03	163·17	160·[illegible]
27/32	196·56	192·70	189·0	185·43	182·00	178·69	175·5	172·42	169·44	166·57
7/8	203·84	199·84	196·0	192·30	188·74	185·30	182·0	178·80	175·72	172·74
29/32	211·12	206·98	203·0	199·16	195·48	191·92	188·5	185·19	182·0	178·91
15/16	218·40	214·11	210·0	206·03	202·22	198·54	195·0	191·57	188·27	185·[illegible]
31/32	225·68	221·25	217·0	212·90	208·96	205·16	201·5	197·96	194·55	191·[illegible]
1	232·96	228·39	224·0	219·77	215·70	211·78	208·0	204·35	200·82	197·42
1 1/32	240·24	235·52	231·0	226·64	222·44	218·40	214·5	210·73	207·10	203·[illegible]
1 1/16	247·52	242·66	238·0	233·50	229·18	225·01	221·0	217·12	213·37	209·[illegible]
1 3/32	254·80	249·80	245·0	240·37	235·92	231·63	227·5	223·50	219·65	215·[illegible]
1 1/8	262·08	256·94	252·0	247·24	242·66	238·25	234·0	229·89	225·93	222·[illegible]
1 5/32	269·36	264·07	259·0	254·11	249·40	244·87	240·5	236·28	232·20	228·[illegible]
1 3/16	276·64	271·21	266·0	260·98	256·14	251·49	247·0	242·66	238·48	234·[illegible]
1 7/32	283·92	278·35	273·0	267·84	262·88	258·10	253·5	249·05	244·75	240·[illegible]
1 1/4	291·20	285·49	280·0	274·71	269·62	264·72	260·0	255·43	251·03	246·[illegible]
1 9/32	298·48	292·62	287·0	281·58	276·37	271·34	266·5	261·82	257·31	252·[illegible]
1 5/16	305·76	299·76	294·0	288·45	283·11	277·96	273·0	268·21	263·58	259·[illegible]
1 11/32	313·04	306·90	301·0	295·32	289·85	284·58	279·5	274·59	269·86	265·[illegible]
1 3/8	320·32	314·03	308·0	302·18	296·59	291·20	286·0	280·98	276·13	271·[illegible]

N = Numeral. % = Calculated percentage strength of joint. B = Workin[g] Pressure per square inch in pounds. D = Inside diameter in inches.

$$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} = N$$

CYLINDRICAL BOILER SHELLS. Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick. Tensile Strength 26 tons per square inch. Numerals and *Nominal* Factors from 6 to 6·9.	TABLE No. 127.

F 6·0	F 6·1	F 6·2	F 6·3	F 6·4	F 6·5	F 6·6	F 6·7	F 6·8	F 6·9
N	N	N	N	N	N	N	N	N	N
48·53	47·73	46·96	46·22	45·50	44·80	44·12	43·46	42·82	42·20
54·60	53·70	52·83	52·0	51·18	50·40	49·63	48·89	48·17	47·47
60·66	59·67	58·70	57·77	56·87	56·0	55·15	54·32	53·52	52·75
66·73	65·63	64·58	63·55	62·56	61·60	60·66	59·76	58·88	58·02
72·80	71·60	70·45	69·33	68·25	67·20	66·18	65·19	64·23	63·30
78·86	77·57	76·32	75·11	73·93	72·80	71·69	70·62	69·58	68·57
84·93	83·54	82·19	80·88	79·62	78·40	77·21	76·05	74·94	73·85
91·0	89·50	88·06	86·66	85·31	84·0	82·72	81·49	80·29	79·13
97·06	95·47	93·93	92·44	91·0	89·60	88·24	86·92	85·64	84·40
03·13	101·44	99·80	98·22	96·68	95·20	93·75	92·35	91·0	89·68
09·20	107·40	105·67	104·0	102·37	100·80	99·27	97·79	96·35	94·95
15·26	113·37	111·54	109·77	108·06	106·40	104·78	103·22	101·70	100·23
21·33	119·34	117·41	115·55	113·75	112·0	110·30	108·65	107·05	105·50
27·40	125·31	123·29	121·33	119·43	117·60	115·81	114·08	112·41	110·78
33·46	131·27	129·16	127·11	125·12	123·20	121·33	119·52	117·76	116·05
39·53	137·24	135·03	132·88	130·81	128·80	126·84	124·95	123·11	121·33
45·60	143·21	140·90	138·66	136·50	134·40	132·36	130·38	128·47	126·60
51·66	149·18	146·77	144·44	142·18	140·0	137·87	135·82	133·82	131·88
57·73	155·14	152·64	150·22	147·87	145·60	143·39	141·25	139·17	137·15
63·80	161·11	158·51	156·0	153·56	151·20	148·90	146·68	144·52	142·43
69·86	167·08	164·38	161·77	159·25	156·80	154·42	152·11	149·88	147·71
75·93	173·04	170·25	167·55	164·93	162·40	159·93	157·55	155·23	152·98
82·0	179·01	176·12	173·33	170·62	168·0	165·45	162·98	160·58	158·26
88·06	184·98	182·0	179·11	176·31	173·60	170·96	168·41	165·94	163·53
94·13	190·95	187·87	184·88	182·0	179·20	176·48	173·85	171·29	168·81
00·20	196·91	193·74	190·66	187·68	184·80	182·0	179·28	176·64	174·08
06·26	202·88	199·61	196·44	193·37	190·40	187·51	184·71	182·0	[illegible]
12·33	208·85	205·48	202·22	199·06	196·0	193·03	190·14	187·35	[illegible]
18·40	214·81	211·35	208·0	204·75	201·60	198·54	195·58	192·70	[illegible]
24·46	220·78	217·22	213·77	210·43	207·20	204·06	201·01	198·05	[illegible]
30·53	226·75	223·09	219·55	216·12	212·80	209·57	206·44	203·41	[illegible]
36·60	232·72	228·96	225·33	221·81	218·40	215·09	211·88	208·76	[illegible]
42·66	238·68	234·83	231·11	227·5	224·0	220·60	217·31	[illegible]	[illegible]
48·73	244·65	240·70	236·88	233·18	229·60	226·12	222·74	[illegible]	[illegible]
54·80	250·62	246·58	242·66	238·87	235·20	231·63	228·17	[illegible]	[illegible]
60·86	256·59	252·45	248·44	244·56	240·80	237·15	233·61	[illegible]	[illegible]
66·93	262·55	258·32	254·22	250·25	246·40	242·66	239·04	[illegible]	[illegible]

…neral. %=Calculated percentage strength of joint. …
…re per square inch in pounds. D=Inside diam…

$\frac{\ldots\times\%}{D} = B \qquad \frac{N\times\%}{B} = D \qquad \frac{D\times B}{N} = \%$ …

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 27 tons per square inch.

Numerals and *Nominal* Factors from 5 to 5·9.

Thickness of Plate.	F 5·0	F 5·1	F 5·2	F 5·3	F 5·4	F 5·5	F 5·6	F 5·7	F 5·8	F 5·9
inches.	N	N	N	N	N	N	N	N	N	N
$\frac{1}{4}$	60·48	59·29	58·15	57·05	56·0	54·98	54·0	53·05	52·13	51·25
$\frac{9}{32}$	68·04	66·70	65·42	64·18	63·0	61·85	60·75	59·68	58·65	57·66
$\frac{5}{16}$	75·60	74·11	72·69	71·32	70·0	68·72	67·50	66·31	65·17	64·07
$\frac{11}{32}$	83·16	81·52	79·96	78·45	77·0	75·60	74·25	72·94	71·68	70·47
$\frac{3}{8}$	90·72	88·94	87·23	85·58	84·0	82·47	81·0	79·57	78·20	76·88
$\frac{13}{32}$	98·28	96·35	94·50	92·71	91·0	89·34	87·75	86·21	84·72	83·28
$\frac{7}{16}$	105·84	103·76	101·76	99·84	98·0	96·21	94·50	92·84	91·24	89·69
$\frac{15}{32}$	113·40	111·17	109·03	106·98	105·0	103·09	101·25	99·47	97·75	96·10
$\frac{1}{2}$	120·96	118·58	116·30	114·11	112·0	109·96	108·0	106·10	104·27	102·51
$\frac{17}{32}$	128·52	126·0	123·57	121·24	119·0	116·83	114·75	112·73	110·79	108·91
$\frac{9}{16}$	136·08	133·41	130·84	128·37	126·0	123·70	121·5	119·36	117·31	115·32
$\frac{19}{32}$	143·64	140·82	138·11	135·50	133·0	130·58	128·25	126·0	123·82	121·72
$\frac{5}{8}$	151·20	148·23	145·38	142·64	140·0	137·45	135·0	132·63	130·34	128·13
$\frac{21}{32}$	158·76	155·64	152·65	149·77	147·0	144·32	141·75	139·26	136·86	134·54
$\frac{11}{16}$	166·32	163·05	159·92	156·90	154·0	151·20	148·5	145·89	143·37	140·94
$\frac{23}{32}$	173·88	170·47	167·19	164·03	161·0	158·07	155·25	152·52	149·89	147·35
$\frac{3}{4}$	181·44	177·88	174·46	171·16	168·0	164·94	162·0	159·15	156·41	153·76
$\frac{25}{32}$	189·0	185·29	181·73	178·30	175·0	171·81	168·75	165·78	162·93	160·16
$\frac{13}{16}$	196·56	192·70	189·0	185·43	182·0	178·69	175·5	172·42	169·44	166·57
$\frac{27}{32}$	204·12	200·11	196·26	192·56	189·0	185·56	182·25	179·05	175·96	172·98
$\frac{7}{8}$	211·68	207·52	203·53	199·69	196·0	192·43	189·0	185·68	182·48	179·38
$\frac{29}{32}$	219·24	214·94	210·80	206·83	203·0	199·30	195·75	192·31	189·0	185·79
$\frac{15}{16}$	226·80	222·35	218·07	213·96	210·0	206·18	202·5	198·94	195·51	192·20
$\frac{31}{32}$	234·36	229·76	225·34	221·09	217·0	213·05	209·25	205·57	202·03	198·61
1	241·92	237·17	232·61	228·22	224·0	219·92	216·0	212·21	208·55	205·01
$1\frac{1}{32}$	249·48	244·58	239·88	235·35	231·0	226·80	222·75	218·84	215·06	211·42
$1\frac{1}{16}$	257·04	252·0	247·15	242·49	238·0	233·67	229·5	225·47	221·58	217·83
$1\frac{3}{32}$	264·60	259·41	254·42	249·62	245·0	240·54	236·25	232·10	228·10	224·23
$1\frac{1}{8}$	272·16	266·82	261·69	256·75	252·0	247·41	243·0	238·73	234·62	230·64
$1\frac{5}{32}$	279·72	274·23	268·96	263·88	259·0	254·29	249·75	245·36	241·13	237·05
$1\frac{3}{16}$	287·28	281·64	276·23	271·01	266·0	261·16	256·5	252·0	247·65	243·45
$1\frac{7}{32}$	294·84	289·05	283·50	278·15	273·0	268·03	263·25	258·63	254·17	249·86
$1\frac{1}{4}$	302·40	296·47	290·76	285·28	280·0	274·90	270·0	265·26	260·68	256·27
$1\frac{9}{32}$	309·96	303·88	298·03	292·41	287·0	281·78	276·75	271·89	267·20	262·67
$1\frac{5}{16}$	317·52	311·29	305·30	299·54	294·0	288·65	283·5	278·52	273·72	269·08
$1\frac{11}{32}$	325·08	318·70	312·57	306·67	301·0	295·52	290·25	285·15	280·24	275·49
$1\frac{3}{8}$	332·64	326·11	319·84	313·81	308·0	302·40	297·0	291·78	286·75	281·89

N=Numeral. %=Calculated percentage strength of joint. B=Working pressure per square inch in pounds. D=Inside diameter in inches.

$$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} = N$$

CYLINDRICAL BOILER SHELLS.

TABLE No. 129.

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 27 tons per square inch.

Numerals and *Nominal* Factors from 6 to 6·9.

F 6·0	F 6·1	F 6·2	F 6·3	F 6·4	F 6·5	F 6·6	F 6·7	F 6·8	F 6·9
N	N	N	N	N	N	N	N	N	N
50·40	49·57	48·77	48·0	47·25	46·52	45·81	45·13	44·47	43·82
56·70	55·77	54·87	54·0	53·15	52·33	51·54	50·77	50·02	49·30
63·0	61·96	60·96	60·0	59·06	58·15	57·27	56·41	55·58	54·78
69·30	68·16	67·06	66·0	64·96	63·96	63·0	62·05	61·14	60·26
75·60	74·36	73·16	72·0	70·87	69·78	68·72	67·70	66·70	65·73
81·90	80·55	79·25	78·0	76·78	75·60	74·45	73·34	72·26	71·21
88·20	86·75	85·35	84·0	82·68	81·41	80·18	78·98	77·82	76·69
94·50	92·95	91·45	90·0	88·59	87·23	85·90	84·62	83·38	82·17
00·80	99·14	97·54	96·0	94·50	93·04	91·63	90·26	88·94	87·65
07·10	105·34	103·64	102·0	100·40	98·86	97·36	95·91	94·50	93·13
13·40	111·54	109·74	108·0	106·31	104·67	103·09	101·55	100·05	98·60
19·70	117·73	115·83	114·0	112·21	110·49	108·81	107·19	105·61	104·08
26·0	123·93	121·93	120·0	118·12	116·30	114·54	112·83	111·17	109·56
32·30	130·13	128·03	126·0	124·03	122·12	120·27	118·47	116·73	115·04
38·60	136·32	134·12	132·0	129·93	127·93	126·0	124·11	122·29	120·52
44·90	142·52	140·22	138·0	135·84	133·75	131·72	129·76	127·85	126·0
51·20	148·72	146·32	144·0	141·75	139·56	137·45	135·40	133·41	131·47
57·50	154·91	152·41	150·0	147·65	145·38	143·18	141·04	138·97	136·95
63·80	161·11	158·51	156·0	153·56	151·20	148·90	146·68	144·52	142·43
70·10	167·31	164·61	162·0	159·46	157·01	154·63	152·32	150·08	147·91
76·40	173·50	170·70	168·0	165·37	162·83	160·36	157·97	155·64	153·39
82·70	179·70	176·80	174·0	171·28	168·64	166·09	163·61	161·20	158·86
89·0	185·90	182·90	180·0	177·18	174·46	171·81	169·25	166·76	164·34
95·30	192·09	189·0	186·0	183·09	180·27	177·54	174·89	172·32	169·82
01·60	198·29	195·09	192·0	189·0	186·09	183·27	180·53	177·88	175·30
07·90	204·49	201·19	198·0	194·90	191·90	189·0	186·17	183·44	180·78
14·20	210·68	207·29	204·0	200·81	197·72	194·72	191·82	189·0	186·26
20·50	216·88	213·38	210·0	206·71	203·53	200·45	197·46	194·55	191·73
26·80	223·08	219·48	216·0	212·62	209·35	206·18	203·10	200·11	197·21
33·10	229·27	225·58	222·0	218·53	215·16	211·90	208·74	205·67	202·69
39·40	235·47	231·67	228·0	224·43	220·98	217·63	214·38	211·23	208·17
45·70	241·67	237·77	234·0	230·34	226·80	223·36	220·02	216·79	213·65
52·0	247·86	243·87	240·0	236·25	232·61	229·09	225·67	222·35	219·13
58·30	254·06	249·96	246·0	242·15	238·43	234·81	231·31	227·91	224·60
64·60	260·26	256·06	252·0	248·06	244·24	240·54	236·95	233·47	230·08
70·90	266·45	262·16	258·0	253·96	250·06	246·27	242·59	239·02	235·56
77·20	272·65	268·25	264·0	259·87	255·87	252·0	248·23	244·58	241·04

eral. %=Calculated percentage strength of joint. B=Working
ure per square inch in pounds. D=Inside diameter in inches.

$\frac{\times\%}{D} = B \qquad \frac{N\times\%}{B} = D \qquad \frac{D\times B}{N} = \% \qquad \frac{D\times B}{\%} = N$

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 28 tons per square inch.

Numerals and *Nominal* Factors from 5 to 5·9.

Thickness of Plate.	F 5·0	F 5·1	F 5·2	F 5·3	F 5·4	F 5·5	F 5·6	F 5·7	F 5·8	F 5·9
inches.	N	N	N	N	N	N	N	N	N	N
$\frac{1}{4}$	62·72	61·49	60·30	59·16	58·07	57·01	56·0	55·01	54·06	53·1
$\frac{9}{32}$	70·56	69·17	67·84	66·56	65·33	64·14	63·0	61·89	60·82	59·7
$\frac{5}{16}$	78·40	76·86	75·38	73·96	72·59	71·27	70·0	68·77	67·58	66·4
$\frac{11}{32}$	86·24	84·54	82·92	81·35	79·85	78·40	77·0	75·64	74·34	73·0
$\frac{3}{8}$	94·08	92·23	90·46	88·75	87·11	85·52	84·0	82·52	81·10	79·7
$\frac{13}{32}$	101·92	99·92	98·0	96·15	94·37	92·65	91·0	89·40	87·86	86·3
$\frac{7}{16}$	109·76	107·60	105·53	103·54	101·62	99·78	98·0	96·28	94·62	93·01
$\frac{15}{32}$	117·60	115·29	113·07	110·94	108·88	106·90	105·0	103·15	101·37	99·6
$\frac{1}{2}$	125·44	122·98	120·61	118·33	116·14	114·03	112·0	110·03	108·13	106·3
$\frac{17}{32}$	133·28	130·66	128·15	125·73	123·40	121·16	119·0	116·91	114·89	112·9
$\frac{9}{16}$	141·12	138·35	135·69	133·13	130·66	128·29	126·0	123·78	121·65	119·5
$\frac{19}{32}$	148·96	146·03	143·23	140·52	137·92	135·41	133·0	130·66	128·41	126·2
$\frac{5}{8}$	156·80	153·72	150·76	147·92	145·18	142·54	140·0	137·54	135·17	132·8
$\frac{21}{32}$	164·64	161·41	158·30	155·32	152·44	149·67	147·0	144·42	141·93	139·5
$\frac{11}{16}$	172·48	169·09	165·84	162·71	159·70	156·80	154·0	151·29	148·68	146·1
$\frac{23}{32}$	180·32	176·78	173·38	170·11	166·96	163·92	161·0	158·17	155·44	152·8
$\frac{3}{4}$	188·16	184·47	180·92	177·50	174·22	171·05	168·0	165·05	162·20	159·4
$\frac{25}{32}$	196·0	192·15	188·46	184·90	181·48	178·18	175·0	171·92	168·96	166·1
$\frac{13}{16}$	203·84	199·84	196·0	192·30	188·74	185·30	182·0	178·80	175·72	172·7
$\frac{27}{32}$	211·68	207·52	203·53	199·69	196·0	192·43	189·0	185·68	182·48	179·3
$\frac{7}{8}$	219·52	215·21	211·07	207·09	203·25	199·56	196·0	192·56	189·24	186·0
$\frac{29}{32}$	227·36	222·90	218·61	214·49	210·51	206·69	203·0	199·43	196·0	192·6
$\frac{15}{16}$	235·20	230·58	226·15	221·88	217·77	213·81	210·0	206·31	202·75	199·3
$\frac{31}{32}$	243·04	238·27	233·69	229·28	225·03	220·94	217·0	213·19	209·51	205·9
1	250·88	245·96	241·23	236·67	232·29	228·07	224·0	220·07	216·27	212·6
$1\frac{1}{32}$	258·72	253·64	248·76	244·07	239·55	235·20	231·0	226·94	223·03	219·2
$1\frac{1}{16}$	266·56	261·33	256·30	251·47	246·81	242·32	238·0	233·82	229·79	225·8
$1\frac{3}{32}$	274·40	269·01	263·84	258·86	254·07	249·45	245·0	240·70	236·55	232·5
$1\frac{1}{8}$	282·24	276·70	271·38	266·20	261·33	256·58	252·0	247·57	243·31	239·1
$1\frac{5}{32}$	290·08	284·39	278·92	273·66	268·59	263·70	259·0	254·45	250·06	245·8
$1\frac{3}{16}$	297·92	292·07	286·46	281·05	275·85	270·83	266·0	261·33	256·82	252·4
$1\frac{7}{32}$	305·76	299·76	294·0	288·45	283·11	277·96	273·0	268·21	263·58	259·1
$1\frac{1}{4}$	313·60	307·45	301·53	295·84	290·37	285·09	280·0	275·08	270·34	265·7
$1\frac{9}{32}$	321·44	315·13	309·07	303·24	297·62	292·21	287·0	281·96	277·10	272·4
$1\frac{5}{16}$	329·28	322·82	316·61	310·64	304·88	299·34	294·0	288·84	283·86	279·0
$1\frac{11}{32}$	337·12	330·50	324·15	318·03	312·14	306·47	301·0	295·71	290·62	285·6
$1\frac{3}{8}$	344·96	338·19	331·69	325·43	319·40	313·60	308·0	302·59	297·37	292·3

N = Numeral. % = Calculated percentage strength of joint. B = Working pressure per square inch in pounds. D = Inside diameter in inches.

$$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} = N$$

CYLINDRICAL BOILER SHELLS.

TABLE No. 131.

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 28 tons per square inch.

Numerals and *Nominal* Factors from 6 to 6·9.

F 6·0	F 6·1	F 6·2	F 6·3	F 6·4	F 6·5	F 6·6	F 6·7	F 6·8	F 6·9
N	N	N	N	N	N	N	N	N	N
52·26	51·40	50·58	49·77	49·0	48·24	47·51	46·80	46·11	[illegible]
58·80	57·83	56·90	56·0	55·12	54·27	53·45	52·65	51·88	[illegible]
65·33	64·26	63·22	62·22	61·25	60·30	59·39	58·50	57·64	[illegible]
71·86	70·68	69·54	68·44	67·37	66·33	65·33	64·35	63·41	[illegible]
78·40	77·11	75·87	74·66	73·50	72·36	71·27	70·20	69·17	[illegible]
84·93	83·54	82·19	80·88	79·62	78·40	77·21	76·05	[illegible]	[illegible]
91·46	89·96	88·51	87·11	85·75	84·43	83·15	81·91	[illegible]	[illegible]
98·0	96·39	94·83	93·33	91·87	90·46	89·09	87·76	[illegible]	[illegible]
104·53	102·81	101·16	99·55	98·0	96·49	95·03	93·61	92·23	[illegible]
111·06	109·24	107·48	105·77	104·12	102·52	100·96	99·46	[illegible]	[illegible]
117·60	115·67	113·80	112·0	110·25	108·55	106·90	105·31	103·76	[illegible]
124·13	122·09	120·12	118·22	116·37	114·58	112·84	111·16	109·52	[illegible]
130·66	128·52	126·45	124·44	122·50	120·61	118·78	117·01	115·29	[illegible]
137·20	134·95	132·77	130·66	128·62	126·64	124·72	122·86	121·05	[illegible]
143·73	141·37	139·09	136·88	134·75	132·67	130·66	128·71	126·82	[illegible]
150·26	147·80	145·41	143·11	140·87	138·70	136·60	134·56	132·58	[illegible]
156·80	154·22	151·74	149·33	147·0	144·73	142·54	140·41	138·35	[illegible]
163·33	160·65	158·06	155·55	153·12	150·76	148·48	146·26	144·11	[illegible]
169·86	167·08	164·38	161·77	159·25	156·80	154·42	152·11	149·88	[illegible]
176·40	173·50	170·70	168·0	165·37	162·83	160·36	157·97	155·64	[illegible]
182·93	179·93	177·03	174·22	171·50	168·86	166·30	163·82	161·41	[illegible]
189·46	186·36	183·35	180·44	177·62	174·89	172·24	169·67	167·17	[illegible]
196·00	192·78	189·67	186·66	183·75	180·92	178·18	175·52	[illegible]	[illegible]
202·53	199·21	196·0	192·88	189·87	186·95	184·12	181·37	[illegible]	[illegible]
209·06	205·63	202·32	199·11	196·0	192·98	190·06	187·22	[illegible]	[illegible]
215·60	212·06	208·64	205·33	202·12	199·01	196·0	193·07	[illegible]	[illegible]
222·13	218·49	214·96	211·55	208·25	205·04	201·93	198·92	[illegible]	[illegible]
228·66	224·91	221·29	217·77	214·37	211·07	207·87	204·77	[illegible]	[illegible]
235·20	231·34	227·61	224·0	220·5	217·10	213·81	[illegible]	[illegible]	[illegible]
241·73	237·77	233·93	230·22	226·62	223·13	219·75	216·47	[illegible]	[illegible]
248·26	244·19	240·25	236·44	232·75	229·16	225·69	[illegible]	[illegible]	[illegible]
254·80	250·62	246·58	242·66	238·87	235·20	231·63	[illegible]	[illegible]	[illegible]
261·33	257·04	252·90	248·88	245·0	241·23	237·57	[illegible]	[illegible]	[illegible]
267·86	263·47	259·22	255·11	251·12	247·26	243·51	[illegible]	[illegible]	[illegible]
274·40	269·90	265·54	261·33	257·25	253·29	249·45	[illegible]	[illegible]	[illegible]
280·93	276·32	271·87	267·55	263·37	259·32	[illegible]	[illegible]	[illegible]	[illegible]
287·46	282·75	278·19	273·77	269·5	265·35	[illegible]	[illegible]	[illegible]	[illegible]

...meral. %=Calculated percentage strength [illegible] working ...sure per square inch in pounds. D=Insi[illegible]

$\frac{N \times \%}{D} = B$ $\frac{N \times \%}{B} = D$ $\frac{D \times B}{\%}$ [illegible] $= N$

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 29 tons per square inch.

Numerals and *Nominal* Factors from 5 to 5·9.

Thickness of Plate.	F 5·0	F 5·1	F 5·2	F 5·3	F 5·4	F 5·5	F 5·6	F 5·7	F 5·8	F 5·9
inches.	N	N	N	N	N	N	N	N	N	N
1/4	64·96	63·68	62·46	61·28	60·14	59·05	58·0	56·98	56·0	55·05
9/32	73·08	71·64	70·26	68·94	67·66	66·43	65·25	64·10	63·0	61·93
5/16	81·20	79·60	78·07	76·60	75·18	73·81	72·5	71·22	70·0	68·81
11/32	89·32	87·56	85·88	84·26	82·70	81·20	79·75	78·35	77·0	75·69
3/8	97·44	95·52	93·69	91·92	90·22	88·58	87·0	85·47	84·0	82·57
13/32	105·56	103·49	101·50	99·58	97·74	95·96	94·25	92·59	91·0	89·45
7/16	113·68	111·45	109·30	107·24	105·25	103·34	101·5	99·71	98·0	96·33
15/32	121·80	119·41	117·11	114·90	112·77	110·72	108·75	106·84	105·0	103·22
1/2	129·92	127·37	124·92	122·56	120·29	118·10	116·0	113·96	112·0	110·10
17/32	138·04	135·33	132·73	130·22	127·81	125·49	123·25	121·08	119·0	116·98
9/16	146·16	143·29	140·53	137·88	135·33	132·87	130·5	128·21	126·0	123·86
19/32	154·28	151·25	148·34	145·54	142·85	140·25	137·75	135·33	133·0	130·74
5/8	162·40	159·21	156·15	153·20	150·37	147·63	145·0	142·45	140·0	137·62
21/32	170·52	167·17	163·96	160·86	157·88	155·01	152·25	149·57	147·0	144·50
11/16	178·64	175·13	171·76	168·52	165·40	162·40	159·5	156·70	154·0	151·38
23/32	186·76	183·09	179·57	176·18	172·92	169·78	166·75	163·82	161·0	158·27
3/4	194·88	191·05	187·38	183·84	180·44	177·16	174·0	170·94	168·0	165·15
25/32	203·0	199·01	195·19	191·50	187·96	184·54	181·25	178·07	175·0	172·03
13/16	211·12	206·98	203·0	199·16	195·48	191·92	188·5	185·19	182·0	178·91
27/32	219·24	214·94	210·80	206·83	203·0	199·30	195·75	192·31	189·0	185·79
7/8	227·36	222·90	218·61	214·49	210·51	206·69	203·0	199·43	196·0	192·67
29/32	235·48	230·86	226·42	222·15	218·03	214·07	210·25	206·56	203·0	199·55
15/16	243·60	238·82	234·23	229·81	225·55	221·45	217·5	213·68	210·0	206·44
31/32	251·72	246·78	242·03	237·47	233·07	228·83	224·75	220·80	217·0	213·32
1	259·84	254·74	249·84	245·13	240·59	236·21	232·0	227·92	224·0	220·20
1 1/32	267·96	262·70	257·65	252·79	248·11	243·60	239·25	235·05	231·0	227·08
1 1/16	276·08	270·66	265·46	260·45	255·62	250·98	246·5	242·17	238·0	233·96
1 3/32	284·20	278·62	273·26	268·11	263·14	258·36	253·75	249·29	245·0	240·84
1 1/8	292·32	286·58	281·07	275·77	270·66	265·74	261·0	256·42	252·0	247·72
1 5/32	300·44	294·54	288·88	283·43	278·18	273·12	268·25	263·54	259·0	254·61
1 3/16	308·56	302·50	296·69	291·09	285·70	280·50	275·5	270·66	266·0	261·49
1 7/32	316·68	310·47	304·50	298·75	293·22	287·89	282·75	277·78	273·0	268·37
1 1/4	324·80	318·43	312·30	306·41	300·74	295·27	290·0	284·91	280·0	275·25
1 9/32	332·92	326·39	320·11	314·07	308·25	302·65	297·25	292·03	287·0	282·13
1 5/16	341·04	334·35	327·92	321·73	315·77	310·03	304·5	299·15	294·0	289·01
1 11/32	349·16	342·31	335·73	329·39	323·29	317·41	311·75	306·28	301·0	295·89
1 3/8	357·28	350·27	343·53	337·05	330·81	324·80	319·0	313·40	308·0	302·77

N=Numeral. %=Calculated percentage strength of joint. B=Working pressure per square inch in pounds. D=Inside diameter in inches.

$$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} = N$$

CYLINDRICAL BOILER SHELLS.

TABLE No. 133.

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.
Tensile Strength 29 tons per square inch.
Numerals and *Nominal* Factors from 6 to 6·9.

F 6·0	F 6·1	F 6·2	F 6·3	F 6·4	F 6·5	F 6·6	F 6·7	F 6·8	F 6·9
N	N	N	N	N	N	N	N	N	N
54·13	53·24	52·38	51·55	50·75	49·96	49·21	48·47	47·76	47·07
60·90	59·90	58·93	58·0	57·09	56·21	55·36	54·53	53·73	52·95
67·66	66·55	65·48	64·44	63·43	62·46	61·51	60·59	59·70	58·84
74·43	73·21	72·03	70·88	69·78	68·70	67·66	66·65	65·67	64·72
81·20	79·86	78·58	77·33	76·12	74·95	73·81	72·71	71·64	70·60
87·96	86·52	85·12	83·77	82·46	81·20	79·96	78·77	77·61	76·49
94·73	93·18	91·67	90·22	88·81	87·44	86·12	84·83	83·58	82·37
101·50	99·83	98·22	96·66	95·15	93·69	92·27	90·89	89·55	88·26
108·26	106·49	104·77	103·11	101·50	99·93	98·42	96·95	95·52	94·14
115·03	113·14	111·32	109·55	107·84	106·18	104·57	103·01	101·50	100·02
121·80	119·80	117·87	116·0	114·18	112·43	110·72	109·07	107·47	105·91
128·56	126·45	124·41	112·44	120·53	118·67	116·87	115·13	113·44	111·79
135·33	133·11	130·96	128·88	126·87	124·92	123·03	121·19	119·41	117·68
142·10	139·77	137·51	135·33	133·21	131·16	129·18	127·25	125·38	123·56
148·86	146·42	144·06	141·77	139·56	137·41	135·33	133·31	131·35	129·44
155·63	153·08	150·61	148·22	145·90	143·66	141·48	139·37	137·32	135·33
162·40	159·73	157·16	154·66	152·25	149·90	147·63	145·43	143·29	141·21
169·16	166·39	163·70	161·11	158·59	156·15	153·78	151·49	149·26	147·10
175·93	173·04	170·25	167·55	164·93	162·40	159·93	157·55	155·23	152·98
182·70	179·70	176·80	174·0	171·28	168·64	166·09	163·61	161·20	158·86
189·46	186·36	183·35	180·44	177·62	174·89	172·24	169·67	167·17	164·75
196·23	193·01	189·90	186·88	183·96	181·13	178·39	175·73	173·14	170·63
203·0	199·67	196·45	193·33	190·31	187·38	184·54	181·79	179·11	176·52
209·76	206·32	203·0	199·77	196·65	193·63	190·69	187·85	185·08	182·40
216·53	212·98	209·54	206·22	203·0	199·87	196·84	193·91	191·05	188·28
223·30	219·63	216·09	212·66	209·34	206·12	203·0	199·97	197·02	194·17
230·06	226·29	222·64	219·11	215·68	212·36	209·15	206·02	203·0	200·05
236·83	232·95	229·19	225·55	222·03	218·61	215·30	212·08	208·97	205·94
243·60	239·60	235·74	232·0	228·37	224·86	221·45	218·14	214·94	211·82
250·36	246·26	242·29	238·44	234·71	231·10	227·60	224·20	220·91	217·71
257·13	252·91	248·83	244·88	241·06	237·35	233·75	230·26	226·88	223·59
263·90	259·57	255·38	251·33	247·40	243·60	239·90	236·32	232·85	229·47
270·66	266·22	261·93	257·77	253·75	249·84	246·06	242·38	238·82	235·36
277·43	272·88	268·48	264·22	260·09	256·09	252·21	248·44	244·79	241·24
284·20	279·54	275·03	270·66	266·43	262·33	258·36	254·50	250·76	247·13
290·96	286·19	281·58	277·11	272·78	268·58	264·51	260·56	256·73	253·01
297·73	292·85	288·12	283·55	279·12	274·83	270·66	266·62	262·70	258·89

meral. %=Calculated percentage strength of joint. B=Working
sure per square inch in pounds. D=Inside diameter in inches.

$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} = N$

CYLINDRICAL BOILER SHELLS.

TABLE No. 134.

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 30 tons per square inch.

Numerals and *Nominal* Factors from 5 to 5·9.

Thickness of Plate.	F 5·0	F 5·1	F 5·2	F 5·3	F 5·4	F 5·5	F 5·6	F 5·7	F 5·8	F 5·9
inches.	N	N	N	N	N	N	N	N	N	N
$\frac{1}{4}$	67·20	65·88	64·61	63·39	62·22	61·09	60·0	58·94	57·93	56·9[illegible]
$\frac{9}{32}$	75·60	74·11	72·69	71·32	70·0	68·72	67·5	66·31	65·17	64·0[illegible]
$\frac{5}{16}$	84·0	82·35	80·76	79·24	77·77	76·36	75·0	73·68	72·41	71·1[illegible]
$\frac{11}{32}$	92·40	90·58	88·84	87·16	85·55	84·0	82·5	81·05	79·65	78·3[illegible]
$\frac{3}{8}$	100·80	98·82	96·92	95·09	93·33	91·63	90·0	88·42	86·89	85·4[illegible]
$\frac{13}{32}$	109·20	107·05	105·0	103·01	101·11	99·27	97·5	95·78	94·13	92·5[illegible]
$\frac{7}{16}$	117·60	115·29	113·07	110·94	108·88	106·90	105·0	103·15	101·37	99·6[illegible]
$\frac{15}{32}$	126·0	123·52	121·15	118·86	116·66	114·54	112·5	110·52	108·62	106·7[illegible]
$\frac{1}{2}$	134·40	131·76	129·23	126·79	124·44	122·18	120·0	117·89	115·86	113·8[illegible]
$\frac{17}{32}$	142·80	140·0	137·30	134·71	132·22	129·81	127·5	125·26	123·10	121·0[illegible]
$\frac{9}{16}$	151·20	148·23	145·38	142·64	140·0	137·45	135·0	132·63	130·34	128·1[illegible]
$\frac{19}{32}$	159·60	156·47	153·46	150·56	147·77	145·09	142·5	140·0	137·58	135·2[illegible]
$\frac{5}{8}$	168·0	164·70	161·53	158·49	155·55	152·72	150·0	147·36	144·82	142·3[illegible]
$\frac{21}{32}$	176·40	172·94	169·61	166·41	163·33	160·36	157·5	154·73	152·06	149·4[illegible]
$\frac{11}{16}$	184·80	181·17	177·69	174·33	171·11	168·0	165·0	162·10	159·31	156·6[illegible]
$\frac{23}{32}$	193·20	189·41	185·76	182·26	178·88	175·63	172·5	169·47	166·55	163·7[illegible]
$\frac{3}{4}$	201·60	197·64	193·84	190·18	186·66	183·27	180·0	176·84	173·79	170·8[illegible]
$\frac{25}{32}$	210·0	205·88	201·92	198·11	194·44	190·90	187·5	184·21	181·03	177·9[illegible]
$\frac{13}{16}$	218·40	214·11	210·0	206·03	202·22	198·54	195·0	191·57	188·27	185·0[illegible]
$\frac{27}{32}$	226·80	222·35	218·07	213·96	210·0	206·18	202·5	198·94	195·51	192·2[illegible]
$\frac{7}{8}$	235·20	230·58	226·15	221·88	217·77	213·81	210·0	206·31	202·75	199·3[illegible]
$\frac{29}{32}$	243·60	238·82	234·23	229·81	225·55	221·45	217·5	213·68	210·0	206·4[illegible]
$\frac{15}{16}$	252·0	247·05	242·30	237·73	233·33	229·09	225·0	221·05	217·24	213·5[illegible]
$\frac{31}{32}$	260·40	255·29	250·38	245·66	241·11	236·72	232·5	228·42	224·48	220·6[illegible]
1	268·80	263·52	258·46	253·58	248·88	244·36	240·0	235·78	231·72	227·7[illegible]
$1\frac{1}{32}$	277·20	271·76	266·53	261·50	256·66	252·0	247·5	243·15	238·96	234·9[illegible]
$1\frac{1}{16}$	285·60	280·0	274·61	269·43	264·44	259·63	255·0	250·52	246·20	242·0[illegible]
$1\frac{3}{32}$	294·0	288·23	282·69	277·35	272·22	267·27	262·5	257·89	253·44	249·1[illegible]
$1\frac{1}{8}$	302·40	296·47	290·76	285·28	280·0	274·90	270·0	265·26	260·68	256·2[illegible]
$1\frac{5}{32}$	310·80	304·70	298·84	293·20	287·77	282·54	277·5	272·63	267·93	263·3[illegible]
$1\frac{3}{16}$	319·20	312·94	306·92	301·13	295·55	290·18	285·0	280·0	275·17	270·5[illegible]
$1\frac{7}{32}$	327·60	321·17	315·0	309·05	303·33	297·81	292·5	287·36	282·41	277·6[illegible]
$1\frac{1}{4}$	336·0	329·41	323·07	316·98	311·11	305·45	300·0	294·73	289·65	284·7[illegible]
$1\frac{9}{32}$	344·40	337·64	331·15	324·90	318·88	313·09	307·5	302·10	296·89	291·8[illegible]
$1\frac{5}{16}$	352·80	345·88	339·23	332·83	326·66	320·72	315·0	309·47	304·13	298·9[illegible]
$1\frac{11}{32}$	361·20	354·11	347·30	340·75	334·44	328·36	322·5	316·84	311·37	306·1[illegible]
$1\frac{3}{8}$	369·60	362·35	355·38	348·67	342·22	336·0	330·0	324·21	318·62	313·2[illegible]

N=Numeral. %=Calculated percentage strength of joint. B=Working pressure per square inch in pounds. D=Inside diameter in inches.

$$\frac{N\times\%}{D} = B \qquad \frac{N\times\%}{B} = D \qquad \frac{D\times B}{N} = \% \qquad \frac{D\times B}{\%} = N$$

CYLINDRICAL BOILER SHELLS.

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 30 tons per square inch.

Numerals and *Nominal* Factors from 6 to 6·9.

Thickness of Plate.	F 6·0	F 6·1	F 6·2	F 6·3	F 6·4	F 6·5	F 6·6	F 6·7	F 6·8	F 6·9
Inches.	N	N	N	N	N	N	N	N	N	N
1/4	56·0	55·08	54·19	53·33	52·50	51·69	50·90	50·14	49·41	48·69
9/32	63·0	61·96	60·96	60·0	59·06	58·15	57·27	56·41	55·58	54·78
5/16	70·0	68·85	67·74	66·66	65·62	64·61	63·63	62·68	61·76	60·86
11/32	77·0	75·73	74·51	73·33	72·18	71·07	70·0	68·95	67·94	66·95
3/8	84·0	82·62	81·29	80·0	78·75	77·53	76·36	75·22	74·11	73·04
13/32	91·0	89·50	88·06	86·66	85·31	84·0	82·72	81·49	80·29	79·13
7/16	98·0	96·39	94·83	93·33	91·87	90·46	89·09	87·76	86·47	85·21
15/32	105·0	103·27	101·61	100·0	98·43	96·92	95·45	94·02	92·64	91·30
1/2	112·0	110·16	108·38	106·66	105·0	103·38	101·81	100·29	98·82	97·39
17/32	119·0	117·04	115·16	113·33	111·56	109·84	108·18	106·56	105·0	103·47
9/16	126·0	123·93	121·93	120·0	118·12	116·30	114·54	112·83	111·17	109·56
19/32	133·0	130·81	128·70	126·66	124·68	122·76	120·90	119·10	117·35	115·65
5/8	140·0	137·70	135·48	133·33	131·25	129·23	127·27	125·37	123·52	121·73
21/32	147·0	144·59	142·25	140·0	137·81	135·69	133·63	131·64	129·70	127·82
11/16	154·0	151·47	149·03	146·66	144·37	142·15	140·0	137·91	135·88	133·91
23/32	161·0	158·36	155·80	153·33	150·93	148·61	146·36	144·17	142·05	140·0
3/4	168·0	165·24	162·58	160·0	157·5	155·07	152·72	150·44	148·23	146·08
25/32	175·0	172·13	169·35	166·66	164·06	161·53	159·09	156·71	154·41	152·17
13/16	182·0	179·01	176·12	173·33	170·62	168·0	165·45	162·98	160·58	158·26
27/32	189·0	185·90	182·90	180·0	177·18	174·46	171·81	169·25	166·76	164·34
7/8	196·0	192·78	189·67	186·66	183·75	180·92	178·18	175·52	172·94	170·43
29/32	203·0	199·67	196·45	193·33	190·31	187·38	184·54	181·79	179·11	176·52
15/16	210·0	206·55	203·22	200·0	196·87	193·84	190·90	188·05	185·29	182·60
31/32	217·0	213·44	210·0	206·66	203·43	200·30	197·27	194·32	191·47	188·69
1	224·0	220·32	216·77	213·33	210·0	206·76	203·63	200·59	197·64	194·78
1 1/32	231·0	227·21	223·54	220·0	216·56	213·23	210·0	206·86	203·82	200·86
1 1/16	238·0	234·09	230·32	226·66	223·12	219·69	216·36	213·13	210·0	206·95
1 3/32	245·0	240·98	237·09	233·33	229·68	226·15	222·72	219·40	216·17	213·04
1 1/8	252·0	247·86	243·87	240·0	236·25	232·61	229·09	225·67	222·35	219·13
1 5/32	259·0	254·75	250·64	246·66	242·81	239·07	235·45	231·94	228·52	225·21
1 3/16	266·0	261·63	257·41	253·33	249·37	245·53	241·81	238·20	234·70	231·30
1 7/32	273·0	268·52	264·19	260·0	255·93	252·0	248·18	244·47	240·88	237·39
1 1/4	280·0	275·40	270·96	266·66	262·50	258·46	254·54	250·74	247·05	243·47
1 9/32	287·0	282·29	277·74	273·33	269·06	264·92	260·90	257·01	253·23	249·56
1 5/16	294·0	289·18	284·51	280·0	275·62	271·38	267·27	263·28	259·41	255·65
1 11/32	301·0	296·06	291·29	286·66	282·18	277·84	273·63	269·55	265·58	261·73
1 3/8	308·0	302·95	298·06	293·33	288·75	284·30	280·0	275·82	271·76	267·82

N = Numeral. % = Calculated percentage strength of joint. B = Working pressure per square inch in pounds. D = Inside diameter in inches.

$$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} = N$$

CYLINDRICAL BOILER SHELLS.

TABLE No. 136.

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 31 tons per square inch.

Numerals and *Nominal* Factors from 5 to 5·9.

Thickness of Plate.	F 5·0	F 5·1	F 5·2	F 5·3	F 5·4	F 5·5	F 5·6	F 5·7	F 5·8	F 5·9
inches.	N	N	N	N	N	N	N	N	N	N
$\frac{1}{4}$	69·44	68·07	66·76	65·50	64·29	63·12	62·0	60·91	59·86	58·84
$\frac{9}{32}$	78·12	76·58	75·11	73·69	72·33	71·01	69·75	68·52	67·34	66·20
$\frac{5}{16}$	86·80	85·09	83·46	81·88	80·37	78·90	77·5	76·14	74·82	73·55
$\frac{11}{32}$	95·48	93·60	91·80	90·07	88·40	86·80	85·25	83·75	82·31	80·91
$\frac{3}{8}$	104·16	102·11	100·15	98·26	96·44	94·69	93·0	91·36	89·79	88·27
$\frac{13}{32}$	112·84	110·62	108·50	106·45	104·48	102·58	100·75	98·98	97·27	95·62
$\frac{7}{16}$	121·52	119·13	116·84	114·64	112·51	110·47	108·5	106·59	104·75	102·98
$\frac{15}{32}$	130·20	127·64	125·19	122·83	120·55	118·36	116·25	114·21	112·24	110·33
$\frac{1}{2}$	138·88	136·15	133·53	131·01	128·59	126·25	124·0	121·82	119·72	117·69
$\frac{17}{32}$	147·56	144·66	141·88	139·20	136·62	134·14	131·75	129·43	127·20	125·05
$\frac{9}{16}$	156·24	153·17	150·23	147·39	144·66	142·03	139·5	137·05	134·68	132·40
$\frac{19}{32}$	164·92	161·68	158·57	155·58	152·70	149·92	147·25	144·66	142·17	139·76
$\frac{5}{8}$	173·60	170·19	166·92	163·77	160·74	157·81	155·0	152·28	149·65	147·11
$\frac{21}{32}$	182·28	178·70	175·26	171·96	168·77	165·70	162·75	159·89	157·13	154·47
$\frac{11}{16}$	190·96	187·21	183·61	180·15	176·81	173·60	170·5	167·50	164·62	161·83
$\frac{23}{32}$	199·64	195·72	191·96	188·33	184·85	181·49	178·25	175·12	172·10	169·18
$\frac{3}{4}$	208·32	204·23	200·30	196·52	192·88	189·38	186·0	182·73	179·58	176·54
$\frac{25}{32}$	217·0	212·74	208·65	204·71	200·92	197·27	193·75	190·35	187·06	183·89
$\frac{13}{16}$	225·68	221·25	217·0	212·90	208·96	205·16	201·5	197·96	194·55	191·25
$\frac{27}{32}$	234·36	229·76	225·34	221·09	217·0	213·05	209·25	205·57	202·03	198·61
$\frac{7}{8}$	243·04	238·27	233·69	229·28	225·03	220·94	217·0	213·19	209·51	205·96
$\frac{29}{32}$	251·72	246·78	242·03	237·47	233·07	228·83	224·75	220·80	217·0	213·32
$\frac{15}{16}$	260·40	255·29	250·38	245·66	241·11	236·72	232·5	228·42	224·48	220·67
$\frac{31}{32}$	269·08	263·80	258·73	253·84	249·14	244·61	240·25	236·03	231·96	228·03
1	277·76	272·31	267·07	262·03	257·18	252·50	248·0	243·64	239·44	235·38
$1\frac{1}{32}$	286·44	280·82	275·42	270·22	265·22	260·40	255·75	251·26	246·93	242·74
$1\frac{1}{16}$	295·12	289·33	283·76	278·41	273·25	268·29	263·5	258·87	254·41	250·10
$1\frac{3}{32}$	303·80	297·84	292·11	286·60	281·29	276·18	271·25	266·49	261·89	257·45
$1\frac{1}{8}$	312·48	306·35	300·46	294·79	289·33	284·07	279·0	274·10	269·37	264·81
$1\frac{5}{32}$	321·16	314·86	308·80	302·98	297·37	291·96	286·75	281·71	276·86	272·16
$1\frac{3}{16}$	329·84	323·37	317·15	311·16	305·40	299·85	294·5	289·33	284·34	279·52
$1\frac{7}{32}$	338·52	331·88	325·50	319·35	313·44	307·74	302·25	296·94	291·82	286·88
$1\frac{1}{4}$	347·20	340·39	333·84	327·54	321·48	315·63	310·0	304·56	299·31	294·23
$1\frac{9}{32}$	355·88	348·90	342·19	335·73	329·51	323·52	317·75	312·17	306·79	301·59
$1\frac{5}{16}$	364·56	357·41	350·53	343·92	337·55	331·41	325·5	319·78	314·27	308·94
$1\frac{11}{32}$	373·24	365·92	358·88	352·11	345·59	339·30	333·25	327·40	321·75	316·30
$1\frac{3}{8}$	381·92	374·43	367·23	360·30	353·62	347·20	341·0	335·01	329·24	323·66

N=Numeral. %=Calculated percentage strength of joint. B=Working pressure per square inch in pounds. D=Inside diameter in inches.

$$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} = N$$

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 31 tons per square inch.

Numerals and *Nominal* Factors from 6 to 6·9.

Thickness of Plate.	F 6·0	F 6·1	F 6·2	F 6·3	F 6·4	F 6·5	F 6·6	F 6·7	F 6·8	F 6·9
inches.	N	N	N	N	N	N	N	N	N	N
1/4	57·86	56·91	56·0	55·11	54·25	53·41	52·60	51·82	51·05	50·31
9/32	65·10	64·03	63·0	62·0	61·03	60·09	59·18	58·29	57·44	56·60
5/16	72·33	71·14	70·0	68·88	67·81	66·76	65·75	64·77	63·82	62·89
11/32	79·56	78·26	77·0	75·77	74·59	73·44	72·33	71·25	70·20	69·18
3/8	86·80	85·37	84·0	82·66	81·37	80·12	78·90	77·73	76·58	75·47
13/32	94·03	92·49	91·0	89·55	88·15	86·80	85·48	84·20	82·97	81·76
7/16	101·26	99·60	98·0	96·44	94·93	93·47	92·06	90·68	89·35	88·05
15/32	108·50	106·72	105·0	103·33	101·71	100·15	98·63	97·16	95·73	94·34
1/2	115·73	113·83	112·0	110·22	108·50	106·83	105·21	103·64	102·11	100·63
17/32	122·96	120·95	119·0	117·11	115·28	113·50	111·78	110·11	108·50	106·92
9/16	130·20	128·06	126·0	124·0	122·06	120·18	118·36	116·59	114·88	113·21
19/32	137·43	135·18	133·0	130·88	128·84	126·86	124·93	123·07	121·26	119·50
5/8	144·66	142·29	140·0	137·77	135·62	133·53	131·51	129·55	127·64	125·79
21/32	151·90	149·40	147·0	144·66	142·40	140·21	138·09	136·02	134·02	132·08
11/16	159·13	156·52	154·0	151·55	149·18	146·89	144·66	142·50	140·41	138·37
23/32	166·36	163·63	161·0	158·44	155·96	153·56	151·24	148·98	146·79	144·66
3/4	173·60	170·75	168·0	165·33	162·75	160·24	157·81	155·46	153·17	150·95
25/32	180·83	177·86	175·0	172·22	169·53	166·92	164·39	161·94	159·55	157·24
13/16	188·06	184·98	182·0	179·11	176·31	173·60	170·96	168·41	165·94	163·53
27/32	195·30	192·09	189·0	186·0	183·09	180·27	177·54	174·89	172·32	169·82
7/8	202·53	199·21	196·0	192·88	189·87	186·95	184·12	181·37	178·70	176·11
29/32	209·76	206·32	203·0	199·77	196·65	193·63	190·69	187·85	185·08	182·40
15/16	217·0	213·44	210·0	206·66	203·43	200·30	197·27	194·32	191·47	188·69
31/32	224·23	220·55	217·0	213·55	210·21	206·98	203·84	200·80	197·85	194·98
1	231·46	227·67	224·0	220·44	217·0	213·66	210·42	207·28	204·23	201·27
1 1/32	238·70	234·78	231·0	227·33	223·78	220·33	217·0	213·76	210·61	207·56
1 1/16	245·93	241·90	238·0	234·22	230·56	227·01	223·57	220·23	217·0	213·85
1 3/32	253·16	249·01	245·0	241·11	237·34	233·69	230·15	226·71	223·38	220·14
1 1/8	260·40	256·13	252·0	248·0	244·12	240·36	236·72	233·19	229·76	226·43
1 5/32	267·63	263·24	259·0	254·88	250·90	247·04	243·30	239·67	236·14	232·72
1 3/16	274·86	270·36	266·0	261·77	257·68	253·72	249·87	246·14	242·52	239·01
1 7/32	282·10	277·47	273·0	268·66	264·46	260·40	256·45	252·62	248·91	245·30
1 1/4	289·33	284·59	280·0	275·55	271·25	267·07	263·03	259·10	255·29	251·59
1 9/32	296·56	291·70	287·0	282·44	278·03	273·75	269·60	265·58	261·67	257·88
1 5/16	303·80	298·81	294·0	289·33	284·81	280·43	276·18	272·05	268·05	264·17
1 11/32	311·03	305·93	301·0	296·22	291·59	287·10	282·75	278·53	274·44	270·46
1 3/8	318·26	313·04	308·0	303·11	298·37	293·78	289·33	285·01	280·82	276·75

N=Numeral. %=Calculated percentage strength of joint. B=Working pressure per square inch in pounds. D=Inside diameter in inches.

$$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} = N$$

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 32 tons per square inch.

Numerals and *Nominal* Factors from 5 to 5·9.

Thickness of Plate.	F 5·0	F 5·1	F 5·2	F 5·3	F 5·4	F 5·5	F 5·6	F 5·7	F 5·8
inches.	N	N	N	N	N	N	N	N	N
1/4	71·68	70·27	68·92	67·62	66·37	65·16	64·0	62·87	61·7
9/32	80·64	79·05	77·53	76·07	74·66	73·30	72·0	70·73	69·5
5/16	89·60	87·84	86·15	84·52	82·96	81·45	80·0	78·59	77·2
11/32	98·56	96·62	94·76	92·98	91·25	89·60	88·0	86·45	84·9
3/8	107·52	105·41	103·38	101·43	99·55	97·74	96·0	94·31	92·6
13/32	116·48	114·19	112·0	109·88	107·85	105·89	104·0	102·17	100·4
7/16	125·44	122·98	120·61	118·33	116·14	114·03	112·0	110·03	108·1
15/32	134·40	131·76	129·23	126·79	124·44	122·18	120·0	117·89	115·8
1/2	143·36	140·54	137·84	135·24	132·74	130·32	128·0	125·75	123·5
17/32	152·32	149·33	146·46	143·69	141·03	138·47	136·0	133·61	131·3
9/16	161·28	158·11	155·07	152·15	149·33	146·61	144·0	141·47	139·0
19/32	170·24	166·90	163·69	160·60	157·62	154·76	152·0	149·33	146·7
5/8	179·20	175·68	172·30	169·05	165·92	162·90	160·0	157·19	154·4
21/32	188·16	184·47	180·92	177·50	174·22	171·05	168·0	165·05	162·2
11/16	197·12	193·25	189·53	185·96	182·51	179·20	176·0	172·91	169·9
23/32	206·08	202·03	198·15	194·41	190·81	187·34	184·0	180·77	177·6
3/4	215·04	210·82	206·76	202·86	199·11	195·49	192·0	188·63	185·3
25/32	224·0	219·60	215·38	211·32	207·40	203·63	200·0	196·49	193·1
13/16	232·96	228·39	224·0	219·77	215·70	211·78	208·0	204·35	200·8
27/32	241·92	237·17	232·61	228·22	224·0	219·92	216·0	212·21	208·5
7/8	250·88	245·96	241·23	236·67	232·29	228·07	224·0	220·07	216·2
29/32	259·84	254·74	249·84	245·13	240·59	236·21	232·0	227·92	224·0
15/16	268·80	263·52	258·46	253·58	248·88	244·36	240·0	235·78	231·7
31/32	277·76	272·31	267·07	262·03	257·18	252·50	248·0	243·64	239·4
1	286·72	281·09	275·69	270·49	265·48	260·65	256·0	251·50	247·1
1 1/32	295·68	289·88	284·30	278·94	273·77	268·80	264·0	259·36	254·8
1 1/16	304·64	298·66	292·92	287·39	282·07	276·94	272·0	267·22	262·6
1 3/32	313·60	307·45	301·53	295·84	290·37	285·09	280·0	275·08	270·3
1 1/8	322·56	316·23	310·15	304·30	298·66	293·23	288·0	282·94	278·0
1 5/32	331·52	325·01	318·76	312·75	306·96	301·38	296·0	290·80	285·7
1 3/16	340·48	333·80	327·38	321·20	315·25	309·52	304·0	298·66	293·5
1 7/32	349·44	342·58	336·0	329·66	323·55	317·67	312·0	306·52	301·2
1 1/4	358·40	351·37	344·61	338·11	331·85	325·81	320·0	314·38	308·9
1 9/32	367·36	360·15	353·23	346·56	340·14	333·96	328·0	322·24	316·6
1 5/16	376·32	368·94	361·84	355·01	348·44	342·10	336·0	330·10	324·4
1 11/32	385·28	377·72	370·46	363·47	356·74	350·25	344·0	337·96	332·1
1 3/8	394·24	386·50	379·07	371·92	365·03	358·40	352·0	345·82	339·8

N=Numeral. %=Calculated percentage strength of joint. B=W
pressure per square inch in pounds. D=Inside diameter in inc

$$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} =$$

CYLINDRICAL BOILER SHELLS.

Steel Plates from $\frac{1}{4}$ inch to $1\frac{3}{8}$ inch thick.

Tensile Strength 32 tons per square inch.

Numerals and *Nominal* Factors from 6 to 6·9.

Thickness of Plate.	F 6·0	F 6·1	F 6·2	F 6·3	F 6·4	F 6·5	F 6·6	F 6·7	F 6·8	F 6·9
inches.	N	N	N	N	N	N	N	N	N	N
1/4	59·73	58·75	57·80	56·88	56·0	55·13	54·30	53·49	52·70	51·94
9/32	67·20	66·09	65·03	64·0	63·0	62·03	61·09	60·17	59·29	58·43
5/16	74·66	73·44	72·25	71·11	70·0	68·92	67·87	66·86	65·88	64·92
11/32	82·13	80·78	79·48	78·22	77·0	75·81	74·66	73·55	72·47	71·42
3/8	89·60	88·13	86·70	85·33	84·0	82·70	81·45	80·23	79·05	77·91
13/32	97·06	95·47	93·93	92·44	91·0	89·60	88·24	86·92	85·64	84·40
7/16	104·53	102·81	101·16	99·55	98·0	96·49	95·03	93·61	92·23	90·89
15/32	112·0	110·16	108·38	106·66	105·0	103·38	101·81	100·29	98·82	97·39
1/2	119·46	117·50	115·61	113·77	112·0	110·27	108·60	106·98	105·41	103·88
17/32	126·93	124·85	122·83	120·88	119·0	117·16	115·39	113·67	112·0	110·37
9/16	134·40	132·19	130·06	128·0	126·0	124·06	122·18	120·35	118·58	116·86
19/32	141·86	139·54	137·29	135·11	133·0	130·95	128·96	127·04	125·17	123·36
5/8	149·33	146·88	144·51	142·22	140·0	137·84	135·75	133·73	131·76	129·85
21/32	156·80	154·22	151·74	149·33	147·0	144·73	142·54	140·41	138·35	136·34
11/16	164·26	161·57	158·96	156·44	154·0	151·63	149·33	147·10	144·94	142·84
23/32	171·73	168·91	166·19	163·55	161·0	158·52	156·12	153·79	151·52	149·33
3/4	179·20	176·26	173·41	170·66	168·0	165·41	162·90	160·47	158·11	155·82
25/32	186·66	183·60	180·64	177·77	175·0	172·30	169·69	167·16	164·70	162·31
13/16	194·13	190·95	187·87	184·88	182·0	179·20	176·48	173·85	171·29	168·81
27/32	201·60	198·29	195·09	192·0	189·0	186·09	183·27	180·53	177·88	175·30
7/8	209·06	205·63	202·32	199·11	196·0	192·98	190·06	187·22	184·47	181·79
29/32	216·53	212·98	209·54	206·22	203·0	199·87	196·84	193·91	191·05	188·28
15/16	224·0	220·32	216·77	213·33	210·0	206·76	203·63	200·59	197·64	194·78
31/32	231·46	227·67	224·0	220·44	217·0	213·66	210·42	207·28	204·23	201·27
1	238·93	235·01	231·22	227·55	224·0	220·55	217·21	213·97	210·82	207·76
1 1/32	246·40	242·36	238·45	234·66	231·0	227·44	224·0	220·65	217·41	214·26
1 1/16	253·86	249·70	245·67	241·77	238·0	234·33	230·78	227·34	224·0	220·75
1 3/32	261·33	257·04	252·90	248·88	245·0	241·23	237·57	234·02	230·58	227·24
1 1/8	268·80	264·39	260·12	256·0	252·0	248·12	244·36	240·71	237·17	233·73
1 5/32	276·26	271·73	267·35	233·11	259·0	255·01	251·15	247·40	243·76	240·23
1 3/16	283·73	279·08	274·58	270·22	266·0	261·90	257·93	254·08	250·35	246·72
1 7/32	291·20	286·42	281·80	277·33	273·0	268·80	264·72	260·77	256·94	253·21
1 1/4	298·66	293·77	289·03	284·44	280·0	275·69	271·51	267·46	263·52	259·71
1 9/32	306·13	301·11	296·25	291·55	287·0	282·58	278·30	274·14	270·11	266·20
1 5/16	313·60	308·45	303·48	298·66	294·0	289·47	285·09	280·83	276·70	272·69
1 11/32	321·06	315·80	310·70	305·77	301·0	296·36	291·87	287·52	283·29	279·18
1 3/8	328·53	323·14	317·93	312·88	308·0	303·26	298·66	294·20	289·88	285·68

N = Numeral. % = Calculated percentage strength of joint. B = Working pressure per square inch in pounds. D = Inside diameter in inches.

$$\frac{N \times \%}{D} = B \qquad \frac{N \times \%}{B} = D \qquad \frac{D \times B}{N} = \% \qquad \frac{D \times B}{\%} = N$$

STEEL PLATES AND STEEL RIVETS.

Riveted Joints.

In the Tables Nos. 140 to 161, which immediately follow these remarks, the particulars as to the proportions of riveted joints made of steel plates with steel rivets are given. By the use of the tables the working pressure may be found for any given diameter of boiler and *nominal* factor of safety, or the diameter determined for a given working pressure and *nominal* factor, or the *nominal* factor ascertained for a given pressure and diameter.

The Tables Nos. 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, have been computed on the assumption that the tensile strength of steel boiler plates is 28 tons per square inch, and the shearing strength of the rivets 23 tons per square inch; the tables on the right hand side of each of these tables give the numerals applicable for steel plates, having tensile strengths of 26, 27, 28, 29, 30, 31 and 32 tons per square inch.

There is frequently a difference of a few tons in the tensile strength of a batch of plates, and it is not unusual, when lightness is of importance, to consider the plates as having a tensile strength above that of the weakest plate in the batch; for instance, if the plates have a tensile strength varying from, say, 27 to 30 tons, 29 tons is frequently used in calculating the working pressure, or if 28 tons be the weakest plate in the batch, 30 tons is frequently used; and in the same way, when 30 tons is the least tensile strength of any of the plates in the batch, 32 tons might be used; but it is more prudent in all cases to take the strength of the weakest plate in making the calculations.

The calculated percentage of joint as given opposite the thickness of plate, in each case, is when the diameter of rivets and pitch of rivets are in accordance with the tables, and centre of rivets to edge of plates and distance between rows of rivets, not less than given opposite the particular thickness of plate.

The pitches of the rivets in column *p* are given in the tables in decimal parts of an inch, but the nearest $\frac{1}{32}$ part of an inch may be adopted without materially affecting the result.

The distance between the rows of rivets in column V, and centre of rivets to edge of plates, in column E, should not be less than given in the table for the description of joint as shown by the sketches at the top of the table and opposite the particular thickness of plate.

N = Numeral opposite the thickness of the plate, and applicable to the description of riveting as shown in the sketches at the top of the table from which the numeral is selected and the riveting proportioned as given opposite the thickness in question. *The table used must always be that for the particular description of joint that is being dealt with, and the numeral that for the particular tensile strength of the plate.*

D = Diameter of boiler, inside, in inches.

B = Working pressure, in lbs. per square inch.

F = Nominal factor of safety, the value of which should in a great measure be determined according to the method of construction.

$$D \times B \times F = N.$$

$$\frac{N}{B \times F} = D.$$

$$\frac{N}{D \times F} = B.$$

$$\frac{N}{D \times B} = F.$$

(1) If the working pressure is required to be found when the longitudinal seams are treble riveted, double butt joints with each alternate rivet omitted in the outer row, either zigzag or chain riveted, the plates of steel $1\frac{1}{4}$ inch thick and the rivets also of steel, the inside diameter of the boiler 172 inches, the *nominal* factor of safety 5, and the tensile strength of the plate 28 tons :—

In the table of steel plates and steel rivets, treble riveted do butt joints, with each alternate rivet omitted in the outer either zigzag or chain riveted, as shown in the sketch at [illegible] of the Table No. 160 opposite $1\frac{1}{4}$, the thickness of the pla[illegible] numeral N (for 28 tons steel) is found to be 133201, and [illegible] be divided by the product of 172, the diameter, and 5, the [illegible] factor, the quotient is the working pressure. The calcu[illegible] centage strength of the joint is 84·95, as found on [illegible] opposite the thickness $1\frac{1}{4}$ inch, which it is, if the r[illegible] the description stated, and the pitch and rivets, &c., [illegible] opposite the thickness of plate, or

$$\frac{133201}{172 \times 5} = 154 \cdot 8 = B,$$

or, say, 155 lbs., [illegible] the working pressur[illegible] inch.

If 30 tons is taken as the tensile strength inste[illegible]

can be found in the same way. The numeral in this case is 142715, then

$$\frac{142715}{172 \times 5} = 165 \cdot 9 = B,$$

or, say, 166 lbs. per square inch.

(2) If the diameter of a boiler is required to be determined when the riveting is the *same* as before and the plates also $1\frac{1}{4}$ inch thick, the *nominal* factor 5, and the pressure 155 pounds:—

Opposite $1\frac{1}{4}$ inch, thickness of plate, the numeral N (for 28 tons steel) is 133201, which divided by 155×5 (the pressure and factor respectively), equals the working pressure, or

$$\frac{133201}{155 \times 5} = 171 \cdot 8 \text{ inches} = D,$$

which is the inside diameter, in inches, the boiler may be, or, say, 172 inches.

If 32 tons were assumed as the tensile strength of the plate, instead of 28 tons, as above, the numeral will be found to be 152229, then

$$\frac{152229}{155 \times 5} = 196 \cdot 4 \text{ inches} = D,$$

or, say, $196\frac{1}{2}$ inches.

(3) If it is wished to determine what thickness the shell of a steel boiler should be if the working pressure is required to be 155 lbs., the diameter 172 inches, and the *nominal* factor 5, and the joints, treble riveted double butt joints with each alternate rivet omitted in the outer row, either zigzag or chain riveted, the steel being assumed at 28 tons tensile strength:—

The product of 155, the pressure, 172, the diameter, and 5, the *nominal* factor, equals 133300, which is practically equal to the numeral 133201, which is the nearest numeral, N (for 28 tons steel), in the table for the description of joint specified, and opposite this numeral the thickness of plate is $1\frac{1}{4}$ inch, which is the thickness the shell should be. The particulars of the riveting and calculated percentage of joint are found on the right opposite the thickness $1\frac{1}{4}$ inch.

(4) If it is wished to determine what factor of safety a boiler is working at when the riveting is the same as before, the plates $1\frac{1}{4}$ inch thick (opposite which the calculated percentage 84·95 is found on the right), the numeral, N (for 28 tons steel), opposite $1\frac{1}{4}$ inch on the left, 133201, the diameter 172 inches and the pressure 155 lbs.:—

The factor of safety is found by dividing the numeral 133201 by the product of 172, the diameter, and 155, the pressure, or

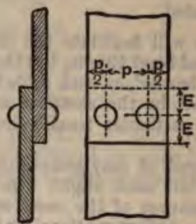
$$\frac{133201}{172 \times 155} = 4.99 = F,$$

ıy, 5, which is the *nominal* factor such a boiler works at under ircumstances stated.

regoing remarks will facilitate the use of any of the Tables l, Steel Plates and Steel Rivets, but the table for the particular ›n of joint must be used, as each table is only applicable to the ›n of joints shown in the sketches at the top of the table, ıumeral for the particular tensile strength of plates which is lt with.

essure, &c., arrived at may sometimes be fractionally over or whole number, but such slight differences can be adjusted ; to the circumstances of the case, even a lb. or two more or not *generally* be a serious matter; for instance, if the pressure t is, say, 158 lbs., no great loss would result from working at and no great harm if at 160 lbs., if the circumstances of the ld make it desirable to do so.

Single Riveted Lap Joints.



28 tons. D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Percentag of Joint.
N	T	d	p	E	
17561	1/4	11/16	1·562	1·031	56·00
19756	9/32	23/32	1·633	1·078	56·00
21952	5/16	3/4	1·704	1·125	56·00
24147	11/32	25/32	1·775	1·171	56·00
26342	3/8	13/16	1·846	1·218	56·00
28537	13/32	27/32	1·917	1·265	56·00
30732	7/16	7/8	1·988	1·312	56·00
32622	15/32	29/32	2·036	1·359	55·48
34326	1/2	15/16	2·071	1·406	54·73
36012	17/32	31/32	2·108	1·453	54·04
37679	9/16	1	2·146	1·500	53·40
39340	19/32	1 1/32	2·186	1·546	52·82
40995	5/8	1 1/16	2·227	1·593	52·29
42633	21/32	1 3/32	2·269	1·640	51·79
44275	11/16	1 1/8	2·312	1·687	51·34
45909	23/32	1 5/32	2·356	1·734	50·92
47529	3/4	1 3/16	2·400	1·781	50·52
49147	25/32	1 7/32	2·445	1·828	50·15
50572	13/16	1 1/4	2·500	1·875	49·62
51851	27/32	1 9/32	2·562	1·921	48·99
53101	7/8	1 5/16	2·625	1·968	48·38
54355	29/32	1 11/32	2·687	2·015	47·84
55636	15/16	1 3/8	2·750	2·062	47·31

N=Numeral appropriate to the thickness of plate and tensile strength of steel.
B=Working pressure, in pounds, per square inch.
D=Diameter of boiler, inside, in inches. F=*Nominal* factor of safety.

$D\times B\times F = N$ $\frac{N}{B\times F} = D$ $\frac{N}{D\times F} = B$ $\frac{N}{D\times B} = F$

NUMERALS.

Riveted Joints in Steel Plates having a Tensile Strength of 26, 27, 28, 29, 30, 31 and 32 tons per square inch.

These numerals are applicable to the thickness of plate which y are opposite, provided the calculated percentage of the joints s given opposite the same thickness in the Table immediately ceding.

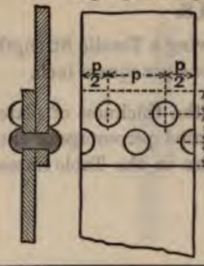
ness ates.	26 tons. D×B×F. N	27 tons. D×B×F. N	28 tons. D×B×F. N	29 tons. D×B×F. N	30 tons. D×B×F. N	31 tons. D×B×F. N	32 tons. D×B×F. N
	16306	16933	17561	18188	18815	19442	20069
32	18344	19050	19756	20461	21167	21872	22578
16	20384	21168	21952	22736	23520	24304	25088
32	22422	23284	24147	25009	25871	26734	27596
	24460	25401	26342	27282	28223	29164	30105
32	26498	27517	28537	29556	30575	31594	32613
16	28536	29634	30732	31829	32927	34024	35122
32	30291	31456	32622	33787	34952	36117	37282
	31874	33100	34326	35551	36777	38003	39229
32	33439	34725	36012	37298	38584	39870	41156
16	34987	36333	37679	39024	40370	41716	43061
32	36530	37935	39340	40745	42150	43555	44960
	38066	39530	40995	42459	43923	45387	46851
32	39587	41110	42633	44155	45678	47200	48723
16	41112	42693	44275	45856	47437	49018	50600
32	42629	44269	45909	47548	49188	50827	52467
	44134	45831	47529	49226	50923	52621	54318
32	45636	47391	49147	50902	52657	54412	56168
16	46959	48765	50572	52378	54184	55990	57796
32	48147	49999	51851	53702	55554	57406	59258
	49308	51204	53101	54997	56893	58790	60686
32	50472	52413	54355	56296	58237	60178	62120
16	51662	53649	55636	57623	59610	61597	63584

=Numeral appropriate to the thickness of plate and tensile strength of steel.
=Working pressure, in pounds, per square inch.
=Diameter of boiler, inside, in inches. F=*Nominal* factor of safety.

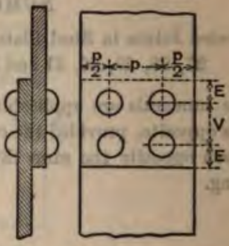
$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

Double Riveted Lap Joints.

Zig Zag Riveting.



Chain Riveting.



28 tons. D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Per age Joi
N	T	d	p	E	V	V	
27440	5/16	11/16	2·291	1·031	1·187	1·875	70
30184	11/32	23/32	2·395	1·078	1·240	1·937	70
32928	3/8	3/4	2·500	1·125	1·295	2·000	70
35672	13/32	25/32	2·604	1·171	1·349	2·062	70
38416	7/16	13/16	2·708	1·218	1·403	2·125	70
41095	15/32	27/32	2·803	1·265	1·453	2·187	69
43458	1/2	7/8	2·850	1·312	1·487	2·250	69
45815	17/32	29/32	2·900	1·359	1·522	2·312	68
48157	9/16	15/16	2·953	1·406	1·558	2·375	68
50489	19/32	31/32	3·008	1·453	1·595	2·437	67
52810	5/8	1	3·064	1·500	1·631	2·500	67
55121	21/32	1 1/32	3·122	1·546	1·669	2·562	66
57427	11/16	1 1/16	3·181	1·593	1·707	2·625	66
59731	23/32	1 3/32	3·241	1·640	1·745	2·687	66
62017	3/4	1 1/8	3·302	1·687	1·784	2·750	65
64307	25/32	1 5/32	3·364	1·734	1·823	2·812	65
66594	13/16	1 3/16	3·427	1·781	1·863	2·875	65
68870	27/32	1 7/32	3·490	1·828	1·902	2·937	65
71146	7/8	1 1/4	3·554	1·875	1·942	3·000	64
73414	29/32	1 9/32	3·618	1·921	1·981	3·062	64
75687	15/16	1 5/16	3·683	1·968	2·021	3·125	64
77942	31/32	1 11/32	3·748	2·015	2·061	3·187	64
80206	1	1 3/8	3·814	2·062	2·102	3·250	63

N = Numeral appropriate to the thickness of plate and tensile strength of steel.
B = Working pressure in pounds per square inch.
D = *Diameter* of boiler, inside, in inches. F = *Nominal* factor of safety.

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

NUMERALS.

Riveted Joints in Steel Plates having a Tensile Strength of 26, 27, 28, 29, 30, 31 and 32 tons per square inch.

hese numerals are applicable to the thickness of plate which are opposite, provided the calculated percentage of the joint given opposite the same thickness in the Table immediately eding.

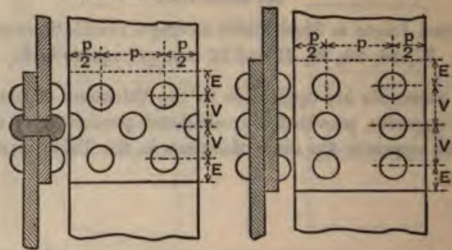
26 tons. D×B×F. N	27 tons. D×B×F. N	28 tons. D×B×F. N	29 tons. D×B×F. N	30 tons D×B×F. N	31 tons. D×B×F. N	32 tons. D×B×F. N
25480	26460	27440	28420	29400	30380	31360
28028	29106	30184	31262	32340	33418	34496
30576	31752	32928	34104	35280	36456	37632
33124	34398	35672	36946	38220	39494	40768
35672	37044	38416	39788	41160	42532	43904
38159	39627	41095	42562	44030	45498	46965
40353	41905	43458	45010	46562	48114	49666
42542	44178	45815	47451	49087	50723	52360
44717	46437	48157	49876	51596	53316	55036
46882	48685	50489	52292	54095	55898	57701
49037	50923	52810	54696	56582	58468	60354
51183	53152	55121	57089	59058	61026	62995
53325	55376	57427	59477	61528	63579	65630
55464	57597	59731	61864	63997	66130	68264
57587	59802	62017	64231	66446	68661	70876
59713	62010	64307	66603	68900	71197	73493
61837	64215	66594	68972	71350	73729	76107
63950	66410	68870	71329	73789	76248	78708
66064	68605	71146	73686	76227	78768	81309
68170	70792	73414	76035	78657	81279	83901
70280	72983	75687	78390	81093	83796	86499
72374	75158	77942	80725	83509	86292	89076
74477	77341	80206	83070	85935	88799	91664

Numeral appropriate to the thickness of plate and tensile strength of steel.
Working pressure, in pounds, per square inch.
Diameter of boiler, inside, in inches. F = *Nominal* factor of safety

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

Treble Riveted Lap Joints.

Zig Zag Riveting. Chain Riveting.



28 tons. D×B×F.	Thick-ness of Plates.	Diam-eter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Perc-age Joi
N	T	d	p	E	V	V	
35750	⅜	11/16	2·864	1·031	1·386	1·875	76·
38729	13/32	23/32	2·994	1·078	1·449	1·937	76·
41708	7/16	¾	3·125	1·125	1·513	2·000	76·
44688	15/32	25/32	3·255	1·171	1·576	2·062	76·
47579	½	13/16	3·367	1·218	1·632	2·125	75·8
50279	17/32	27/32	3·437	1·265	1·674	2·187	75·4
52962	9/16	⅞	3·509	1·312	1·717	2·250	75·0
55636	19/32	29/32	3·583	1·359	1·761	2·312	74·7
58306	⅝	15/16	3·659	1·406	1·805	2·375	74·3
60966	21/32	31/32	3·736	1·453	1·850	2·437	74·0
63627	11/16	1	3·815	1·500	1·895	2·500	73·7
66276	23/32	1 1/32	3·894	1·546	1·940	2·562	73·5
68932	¾	1 1/16	3·975	1·593	1·986	2·625	73·2
71579	25/32	1 3/32	4·057	1·640	2·032	2·687	73·0
74207	13/16	1⅛	4·139	1·687	2·078	2·750	72·8
76850	27/32	1 5/32	4·222	1·734	2·125	2·812	72·6
79488	⅞	1 3/16	4·306	1·781	2·172	2·875	72·4
82111	29/32	1 7/32	4·390	1·828	2·219	2·937	72·2
84742	15/16	1¼	4·475	1·875	2·266	3·000	72·0
87372	31/32	1 9/32	4·560	1·921	2·313	3·062	71·
89990	1	1 5/16	4·646	1·968	2·361	3·125	71·7
92621	1 1/32	1 11/32	4·732	2·015	2·409	3·187	71·
95241	1 1/16	1⅜	4·818	2·062	2·456	3·250	71·

N=Numeral appropriate to the thickness of plate and tensile strength of steel.
B=Working pressure, in pounds, per square inch.
D=*Diameter* of boiler, inside, in inches. F=*Nominal* factor of safety.

$$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$$

NUMERALS.

l Joints in Steel Plates having a Tensile Strength of 26, 7, 28, 29, 30, 31 and 32 tons per square inch.

umerals are applicable to the thickness of plate which posite, provided the calculated percentage of the joint opposite the same thickness in the Table immediately

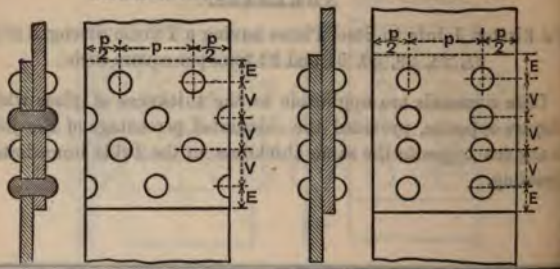
s.	27 tons.	28 tons.	29 tons.	30 tons.	31 tons.	32 tons.
F.	D×B×F.	D×B×F.	D×B×F.	D×B×F.	D×B×F.	D×B×F.
	N	N	N	N	N	N
6	34473	35750	37026	38303	39580	40857
2	37345	38729	40112	41495	42878	44261
8	40218	41708	43197	44687	46176	47666
6	43092	44688	46284	47880	49476	51072
0	45879	47579	49278	50977	52676	54376
7	48483	50279	52074	53870	55666	57461
9	51070	52962	54853	56745	58636	60528
2	53649	55636	57623	59610	61597	63584
1	56223	58306	60388	62470	64553	66635
1	58788	60966	63143	65320	67498	69675
2	61354	63627	65899	68171	70444	72716
2	63909	66276	68643	71010	73377	75744
8	66470	68932	71393	73855	76317	78779
6	69022	71579	74135	76691	79248	81804
6	71556	74207	76857	79507	82157	84808
0	74105	76850	79594	82339	85083	87828
0	76649	79488	82326	85165	88004	90843
5	79178	82111	85043	87976	90908	93841
9	81715	84742	87768	90795	93821	96848
1	84251	87372	90492	93612	96733	99853
2	86776	89990	93203	96417	99631	102845
5	89313	92621	95928	99236	102544	105852
8	91839	95241	98642	102043	105445	108846

appropriate to the thickness of plate and tensile strength of steel.
pressure, in pounds, per square inch.
of boiler, inside, in inches. F = Nominal factor of safety.

$F = N$ $\qquad \frac{N}{B \times F} = D$ $\qquad \frac{N}{D \times F} = B$ $\qquad \frac{N}{D \times B} = F$

Quadruple Riveted Lap Joints.

Zig Zag Riveting. Chain Riveting.



28 tons. D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Chain Riveting.	Percentage of Joint.
N	T	d	p	E	V	V	
43904	$\frac{7}{16}$	$\frac{11}{16}$	3·437	1·031	1·584	1·875	80·00
46934	$\frac{15}{32}$	$\frac{23}{32}$	3·562	1·078	1·645	1·937	79·82
49837	$\frac{1}{2}$	$\frac{3}{4}$	3·653	1·125	1·694	2·000	79·46
52738	$\frac{17}{32}$	$\frac{25}{32}$	3·746	1·171	1·745	2·062	79·14
55629	$\frac{9}{16}$	$\frac{13}{16}$	3·841	1·218	1·795	2·125	78·84
58511	$\frac{19}{32}$	$\frac{27}{32}$	3·937	1·265	1·847	2·187	78·56
61402	$\frac{5}{8}$	$\frac{7}{8}$	4·036	1·312	1·899	2·250	78·32
64275	$\frac{21}{32}$	$\frac{29}{32}$	4·135	1·359	1·952	2·312	78·08
67146	$\frac{11}{16}$	$\frac{15}{16}$	4·236	1·406	2·005	2·375	77·86
70018	$\frac{23}{32}$	$\frac{31}{32}$	4·338	1·453	2·058	2·437	77·66
72883	$\frac{3}{4}$	1	4·440	1·500	2·111	2·500	77·47
75754	$\frac{25}{32}$	$1\frac{1}{32}$	4·544	1·546	2·165	2·562	77·30
78621	$\frac{13}{16}$	$1\frac{1}{16}$	4·648	1·593	2·219	2·625	77·14
81475	$\frac{27}{32}$	$1\frac{3}{32}$	4·752	1·640	2·273	2·687	76·98
84328	$\frac{7}{8}$	$1\frac{1}{8}$	4·857	1·687	2·328	2·750	76·83
87192	$\frac{29}{32}$	$1\frac{5}{32}$	4·963	1·734	2·382	2·812	76·70
90046	$\frac{15}{16}$	$1\frac{3}{16}$	5·069	1·781	2·437	2·875	76·57
92889	$\frac{31}{32}$	$1\frac{7}{32}$	5·175	1·828	2·492	2·937	76·44
95748	1	$1\frac{1}{4}$	5·282	1·875	2·547	3·000	76·33
98598	$1\frac{1}{32}$	$1\frac{9}{32}$	5·389	1·921	2·602	3·062	76·22
101439	$1\frac{1}{16}$	$1\frac{5}{16}$	5·496	1·968	2·657	3·125	76·11
104299	$1\frac{3}{32}$	$1\frac{11}{32}$	5·604	2·015	2·712	3·187	76·01
107138	$1\frac{1}{8}$	$1\frac{3}{8}$	5·711	2·062	2·767	3·250	75·92

N=Numeral appropriate to the thickness of plate and tensile strength of steel.
B=Working pressure, in pounds, per square inch.
D=Diameter of boiler, inside, in inches. F=*Nominal* factor of safety.

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

NUMERALS.

iveted Joints in Steel Plates having a Tensile Strength of 26, 27, 28, 29, 30, 31 and 32 tons per square inch.

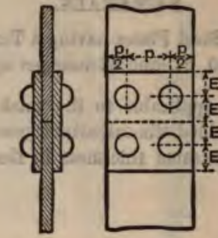
se numerals are applicable to the thickness of plate which re opposite, provided the calculated percentage of the joint iven opposite the same thickness in the Table immediately ing.

26 tons.)×B×F.	27 tons. D×B×F.	28 tons. D×B×F.	29 tons. D×B×F.	30 tons. D×B×F.	31 tons. D×B×F.	32 tons. D×B×F.
N	N	N	N	N	N	N
40768	42336	43904	45472	47040	48608	50176
43581	45257	46934	48610	50286	51962	53638
46277	48057	49837	51616	53396	55176	56956
48971	50854	52738	54621	56505	58388	60272
51655	53642	55629	57615	59602	61589	63576
54331	56421	58511	60600	62690	64780	66869
57032	59226	61420	63613	65807	68000	70194
59683	61979	64275	66570	68866	71161	73457
62350	64748	67147	69545	71943	74341	76739
65016	67517	70018	72518	75019	77519	80020
67677	70280	72883	75485	78088	80691	83294
70343	73048	75754	78459	81165	83870	86576
73005	75813	78621	81428	84236	87044	89852
75655	78565	81475	84384	87294	90204	93114
78304	81316	84328	87339	90351	93363	96374
80964	84078	87192	90306	93420	96534	99648
83614	86830	90046	93261	96477	99693	102909
86254	89571	92889	96206	99523	102841	106158
88908	92328	95748	99167	102587	106006	109426
91555	95076	98598	102119	105640	109162	112683
94193	97816	101439	105061	108684	112307	115930
96849	100574	104299	108023	111748	115473	119198
99485	103311	107138	110964	114790	118617	122443

meral appropriate to the thickness of plate and tensile strength of steel.
rking pressure, in pounds, per square inch.
meter of boiler, inside, in inches. F = *Nominal* factor of safety.

$\times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

Single Riveted Double Butt Joints.



28 tons. D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Thickness of Butt Straps.	Percentage of Joint.
N	T	d	p	E	T_1	
30576	3/8	11/16	1·964	1·031	·234	65·00
33124	13/32	23/32	2·053	1·078	·253	65·00
35672	7/16	3/4	2·142	1·125	·273	65·00
38220	15/32	25/32	2·232	1·171	·292	65·00
40586	1/2	13/16	2·303	1·218	·312	64·71
42769	17/32	27/32	2·356	1·265	·332	64·18
44946	9/16	7/8	2·411	1·312	·351	63·70
47116	19/32	29/32	2·467	1·359	·371	63·26
49290	5/8	15/16	2·525	1·406	·390	62·87
51441	21/32	31/32	2·583	1·453	·410	62·42
53589	11/16	1	2·642	1·500	·429	62·14
55727	23/32	1 1/32	2·701	1·546	·449	61·81
57868	3/4	1 1/16	2·761	1·593	·468	61·51
60015	25/32	1 3/32	2·822	1·640	·488	61·24
62140	13/16	1 1/8	2·883	1·687	·507	60·97
64276	27/32	1 5/32	2·945	1·734	·527	60·73
66393	7/8	1 3/16	3·006	1·781	·546	60·49
68526	29/32	1 7/32	3·069	1·828	·566	60·28
70642	15/16	1 1/4	3·131	1·875	·585	60·07
72766	31/32	1 9/32	3·194	1·921	·605	59·88
74887	1	1 5/16	3·257	1·968	·625	59·70
76995	1 1/32	1 11/32	3·320	2·015	·644	59·52
79101	1 1/16	1 3/8	3·383	2·062	·664	59·35

N = Numeral appropriate to the thickness of plate and tensile strength of steel.
B = Working pressure, in pounds, per square inch.
D = Diameter of boiler, inside, in inches. F = *Nominal* factor of safety.

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

NUMERALS.

ed Joints in Steel Plates having a Tensile Strength of 26, 27, 28, 29, 30, 31, and 32 tons per square inch.

numerals are applicable to the thickness of plate which opposite provided the calculated percentage of the joint n opposite the same thickness in the Table immediately .

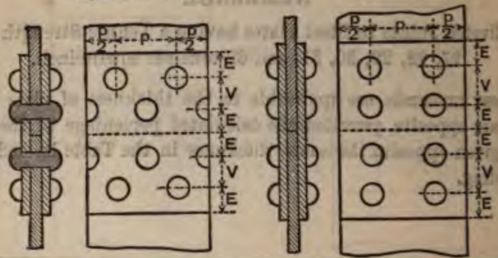
ons.	27 tons.	28 tons.	29 tons.	30 tons.	31 tons.	32 tons.
×F	D×B×F.	D×B×F.	D×B×F.	D×B×F.	D×B×F.	D×B×F.
	N	N	N	N	N	N
92	29484	30576	31668	32760	33852	34944
58	31941	33124	34307	35490	36673	37856
24	34398	35672	36946	38220	39494	40768
90	36855	38220	39585	40950	42315	43680
87	39136	40586	42035	43485	44934	46384
14	41241	42769	44296	45823	47351	48878
35	43340	44946	46551	48156	49761	51366
50	45433	47116	48798	50481	52164	53846
69	47529	49290	51050	52810	54571	56331
66	49603	51441	53278	55115	56952	58789
61	51675	53589	55502	57416	59330	61244
46	53736	55727	57717	59707	61697	63688
34	55801	57868	59934	62001	64068	66134
28	57871	60015	62158	64301	66445	68588
01	59920	62140	64359	66578	68797	71017
84	61980	64276	66571	68867	71162	73458
50	64021	66393	68764	71135	73506	75877
31	66078	68526	70973	73420	75868	78315
96	68119	70642	73164	75687	78210	80733
68	70167	72766	75364	77963	80562	83161
37	72212	74887	77561	80236	82910	85585
95	74245	76995	79744	82494	85244	87994
50	76275	79101	81926	84751	87576	90401

al appropriate to the thickness of plate and tensile strength of steel.
ng pressure, in pounds, per square inch.
ter of boiler, inside, in inches. *F = Nominal* factor of safety.

$\times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D} \ldots$

Double Riveted Double Butt Joints.

Zig Zag Riveting. Chain Riveting.



28 tons. D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Thickness of Butt Straps.	Perc- age Joi
N	T	d	p	E	V	V	T_1	
42806	7/16	11/16	3·126	1·031	1·477	1·875	·273	78·0
45617	15/32	23/32	3·206	1·078	1·522	1·937	·292	77·5
48419	1/2	3/4	3·290	1·125	1·570	2·000	·312	77·2
51212	17/32	25/32	3·375	1·171	1·617	2·062	·332	76·9
53999	9/16	13/16	3·462	1·218	1·665	2·125	·351	76·5
56776	19/32	27/32	3·551	1·265	1·714	2·187	·371	76·2
59552	5/8	7/8	3·641	1·312	1·763	2·250	·390	75·9
62324	21/32	29/32	3·732	1·359	1·812	2·312	·410	75·7
65093	11/16	15/16	3·824	1·406	1·862	2·375	·429	75·4
67854	23/32	31/32	3·917	1·453	1·912	2·437	·449	75·2
70616	3/4	1	4·010	1·500	1·963	2·500	·468	75·0
73372	25/32	1 1/32	4·104	1·546	2·013	2·562	·488	74·8
76124	13/16	1 1/16	4·199	1·593	2·064	2·625	·507	74·6
78882	27/32	1 3/32	4·295	1·640	2·115	2·687	·527	74·5
81628	7/8	1 1/8	4·391	1·687	2·166	2·750	·546	74·3
84384	29/32	1 5/32	4·487	1·734	2·217	2·812	·566	74·2
87118	15/16	1 3/16	4·583	1·781	2·269	2·875	·585	74·0
89864	31/32	1 7/32	4·680	1·828	2·320	2·937	·605	73·9
92612	1	1 1/4	4·778	1·875	2·372	3·000	·625	73·8
95351	1 1/32	1 9/32	4·875	1·921	2·423	3·062	·644	73·7
98094	1 1/16	1 5/16	4·973	1·968	2·475	3·125	·664	73·6
100842	1 3/32	1 11/32	5·071	2·015	2·527	3·187	·683	73·5
103567	1 1/8	1 3/8	5·169	2·062	2·579	3·250	·703	73·3

N = Numeral appropriate to the thickness of plate and tensile strength of steel.
B = Working pressure, in pounds, per square inch.
D = Diameter of boiler, inside, in inches. F = *Nominal* factor of safety.

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

[illegible]

[illegible]

[illegible]

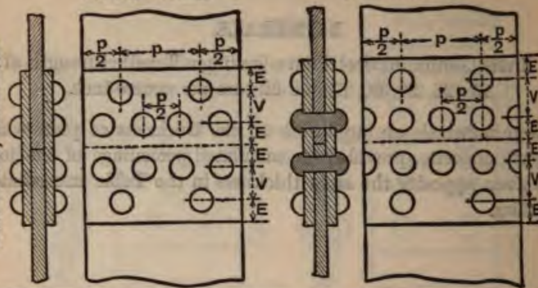
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
83445	86654	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	92812	[illegible]	[illegible]	[illegible]	[illegible]
88546	91945	95351	98756	[illegible]	[illegible]	[illegible]
91667	94590	98094	101537	[illegible]	[illegible]	112107
93639	97240	100842	104443	[illegible]	111646	115248
96169	99568	103567	107265	110964	114663	118362

Numeral appropriate to the thickness of plate and tensile strength of steel
Working pressure, in pounds, per square inch.
Diameter of boiler, inside, in inches. F = Nominal factor of safety.

$D \times B \times F = N$ $\quad \frac{N}{B \times F} = D$ $\quad \frac{N}{D \times F} = B$ $\quad \frac{N}{D \times B} = F$

Zig Zag Riveting. Chain Riveting.

Double Riveted Double Butt Joints, each alternate Rivet omitted on the outer rows.



28 tons. D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Thickness of Butt Straps.	Percentage of Joint.
N	T	d	p	E	V	V	T_1	
51631	1/2	11/16	3·889	1·031	1·578	1·875	·398	82·32
54698	17/32	23/32	4·012	1·078	1·639	1·937	·424	82·08
57767	9/16	3/4	4·137	1·125	1·701	2·000	·451	81·87
60820	19/32	25/32	4·262	1·171	1·762	2·062	·478	81·66
63888	5/8	13/16	4·390	1·218	1·824	2·125	·505	81·49
66942	21/32	27/32	4·518	1·265	1·886	2·187	·532	81·32
69992	11/16	7/8	4·646	1·312	1·948	2·250	·559	81·16
73047	23/32	29/32	4·776	1·359	2·011	2·312	·586	81·02
76101	3/4	15/16	4·906	1·406	2·073	2·375	·613	80·89
79144	25/32	31/32	5·037	1·453	2·136	2·437	·640	80·76
82198	13/16	1	5·168	1·500	2·198	2·500	·668	80·65
85243	27/32	1 1/32	5·300	1·546	2·261	2·562	·695	80·54
88279	7/8	1 1/16	5·432	1·593	2·324	2·625	·722	80·4[illegible]
91330	29/32	1 3/32	5·564	1·640	2·387	2·687	·749	80·3[illegible]
94374	15/16	1 1/8	5·697	1·687	2·450	2·750	·777	80·2[illegible]
97410	31/32	1 5/32	5·830	1·734	2·513	2·812	·804	80·[illegible]
100452	1	1 3/16	5·963	1·781	2·576	2·875	·831	80·[illegible]
103500	1 1/32	1 7/32	6·097	1·828	2·639	2·937	·859	80·[illegible]
106530	1 1/16	1 1/4	6·230	1·875	2·702	3·000	·886	79·[illegible]
109567	1 3/32	1 9/32	6·364	1·921	2·765	3·062	·913	79·[illegible]
112613	1 1/8	1 5/16	6·499	1·968	2·828	3·125	·941	79·[illegible]
115654	1 5/32	1 11/32	6·633	2·015	2·891	3·187	·968	79·[illegible]
118691	1 3/16	1 3/8	6·767	2·062	2·955	3·250	·996	79·[illegible]

N = Numeral appropriate to the thickness of plate and tensile strength of steel.
B = Working pressure, in pounds, per square inch.
D = Diameter of boiler, inside, in inches. F = *Nominal* factor of safety.

$$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$$

NUMERALS.

For Riveted Joints in Steel Plates having a Tensile Strength of 26, 27, 28, 29, 30, 31 and 32 tons per square inch.

These numerals are applicable to the thickness of plate which they are opposite, provided the calculated percentage of the joint is as given opposite the same thickness in the Table immediately preceding.

Thickness of Plates.	26 tons. D×B×F.	27 tons. D×B×F.	28 tons. D×B×F.	29 tons. D×B×F.	30 tons. D×B×F.	31 tons. D×B×F.	32 tons. D×B×F.
T	N	N	N	N	N	N	N
1/2	47943	49787	51631	53474	55318	57162	59006
17/32	50791	52744	54698	56651	58605	60558	62512
9/16	53640	55703	57767	59830	61893	63956	66019
19/32	56475	58647	60820	62992	65164	67336	69508
5/8	59324	61606	63888	66169	68451	70733	73014
21/32	62160	64551	66942	69332	71723	74114	76505
11/16	64992	67492	69992	72491	74991	77491	79990
23/32	67829	70438	73047	75655	78264	80873	83482
3/4	70665	73383	76101	78818	81536	84254	86972
25/32	73490	76317	79144	81970	84797	87623	90450
13/16	76326	79262	82198	85133	88069	91004	93940
27/32	79154	82198	85243	88287	91331	94376	97420
7/8	81973	85126	88279	91431	94584	97737	100890
29/32	84806	88068	91330	94591	97853	101115	104377
15/16	87633	91003	94374	97744	101115	104485	107856
31/32	90452	93931	97410	100888	104367	107846	111325
1	93276	96864	100452	104039	107627	111214	114802
1 1/32	96107	99803	103500	107196	110892	114589	118285
1 1/16	98920	102725	106530	110334	114139	117943	121748
1 3/32	101740	105653	109567	113480	117393	121306	125219
1 1/8	104569	108591	112613	116634	120656	124678	128700
1 5/32	107393	111523	115654	119784	123915	128045	132176
1 3/16	110213	114452	118691	122929	127168	131407	135646

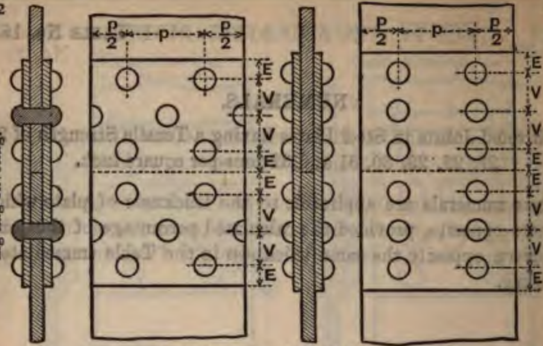
N = Numeral appropriate to the thickness of plate and tensile strength of steel.
B = Working pressure, in pounds, per square inch.
D = Diameter of boiler, inside, in inches. F = *Nominal* factor of safety

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

TABLE No. 154.

Treble Riveted Butt Joints.
Zig Zag Riveting.

Treble Riveted Butt Joints.
Chain Riveting.



Steel Plates and Steel Rivets.

28 tons. D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Thickness of Butt Straps.	Percentage of Joint.
N	T	d	p	E	V	V	T_1	
51631	1/2	11/16	3·889	1·031	1·738	1·875	·312	82·32
54698	17/32	23/32	4·012	1·078	1·799	1·937	·332	82·06
57767	9/16	3/4	4·137	1·125	1·860	2·000	·351	81·87
60820	19/32	25/32	4·262	1·171	1·921	2·062	·371	81·66
63888	5/8	13/16	4·390	1·218	1·984	2·125	·390	81·49
66942	21/32	27/32	4·518	1·265	2·046	2·187	·410	81·32
69992	11/16	7/8	4·646	1·312	2·109	2·250	·429	81·16
73047	23/32	29/32	4·776	1·359	2·172	2·312	·449	81·02
76101	3/4	15/16	4·906	1·406	2·235	2·375	·468	80·89
79144	25/32	31/32	5·037	1·453	2·298	2·437	·488	80·76
82198	13/16	1	5·168	1·500	2·361	2·500	·507	80·65
85243	27/32	1 1/32	5·300	1·546	2·425	2·562	·527	80·54
88279	7/8	1 1/16	5·432	1·593	2·489	2·625	·546	80·43
91330	29/32	1 3/32	5·564	1·640	2·553	2·687	·566	80·34
94374	15/16	1 1/8	5·697	1·687	2·617	2·750	·585	80·25
97410	31/32	1 5/32	5·830	1·734	2·681	2·812	·605	80·16
100452	1	1 3/16	5·963	1·781	2·745	2·875	·625	80·08
103500	1 1/32	1 7/32	6·097	1·828	2·809	2·937	·644	80·01
106530	1 1/16	1 1/4	6·230	1·875	2·873	3·000	·664	79·93
109567	1 3/32	1 9/32	6·364	1·921	2·937	3·062	·683	79·86
112613	1 1/8	1 5/16	6·499	1·968	3·002	3·125	·703	79·80
115654	1 5/32	1 11/32	6·633	2·015	3·067	3·187	·722	79·74
118691	1 3/16	1 3/8	6·767	2·062	3·131	3·250	·742	79·68

N=Numeral appropriate to the thickness of plate and tensile strength of steel.
B=Working pressure, in pounds, per square inch.
D=Diameter of boiler, inside, in inches. F=*Nominal* factor of safety.

$$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$$

NUMERALS.

r Riveted Joints in Steel Plates having a Tensile Strength of 26, 27, 28, 29, 30, 31 and 32 tons, per square inch.

These numerals are applicable to the thickness of plate which ey are opposite, provided the calculated percentage of the joint as given opposite the same thickness in the Table immediately eceding.

ness ates.	26 tons. D×B×F.	27 tons. D×B×F.	28 tons. D×B×F.	29 tons. D×B×F.	30 tons. D×B×F.	31 tons. D×B×F.	32 tons. D×B×F.
	N	N	N	N	N	N	N
	47943	49787	51631	53474	55318	57162	59006
32	50791	52744	54698	56651	58605	60558	62512
16	53640	55703	57767	59830	61893	63956	66019
32	56475	58647	60820	62992	65164	67336	69508
	59324	61606	63888	66169	68451	70733	73014
32	62160	64551	66942	69332	71723	74114	76505
16	64992	67492	69992	72491	74991	77491	79990
32	67829	70438	73047	75655	78264	80873	83482
	70665	73383	76101	78818	81536	84254	86972
32	73490	76317	79144	81970	84797	87623	90450
16	76326	79262	82198	85133	88069	91004	93940
32	79154	82198	85243	88287	91331	94376	97420
	81973	85126	88279	91431	94584	97737	100890
32	84806	88068	91330	94591	97853	101115	104377
16	87633	91003	94374	97744	101115	104485	107856
32	90452	93931	97410	100888	104367	107846	111325
	93276	96864	100452	104039	107627	111214	114802
32	96107	99803	103500	107196	110892	114589	118285
16	98920	102725	106530	110334	114139	117943	121748
32	101740	105653	109567	113480	117393	121306	125219
	104569	108591	112613	116634	120656	124678	128700
32	107393	111523	115654	119784	123915	128045	132176
16	110213	114452	118691	122929	127168	131407	135646

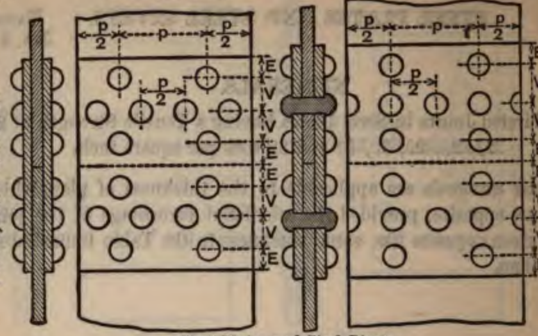
= Numeral appropriate to the thickness of plate and tensile strength of steel.
= Working pressure, in pounds, per square inch.
= Diameter of boiler, inside, in inches. F = *Nominal* factor of safety.

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

Treble Riveted Double Butt Joints, each alternate Rivet omitted in the outer and inner rows.

TABLE No. 156.

Zig Zag Riveting. Chain Riveting.



Steel Plates and Steel Rivets.

28 tons. D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Thickness of Butt Straps.	Percentage of Joint.
N	T	d	p	E	V	V	T_1	
59736	9/16	11/16	4·482	1·031	1·695	1·940	·351	84·66
62957	19/32	23/32	4·648	1·078	1·764	2·015	·371	84·53
66185	5/8	3/4	4·814	1·125	1·834	2·090	·390	84·42
69403	21/32	25/32	4·981	1·171	1·904	2·166	·410	84·31
72622	11/16	13/16	5·148	1·218	1·974	2·242	·429	84·21
75842	23/32	27/32	5·316	1·265	2·044	2·318	·449	84·12
79064	3/4	7/8	5·485	1·312	2·114	2·394	·468	84·04
82280	25/32	29/32	5·653	1·359	2·184	2·470	·488	83·96
85500	13/16	15/16	5·822	1·406	2·255	2·547	·507	83·89
88715	27/32	31/32	5·991	1·453	2·325	2·623	·527	83·82
91934	7/8	1	6·161	1·500	2·395	2·700	·546	83·76
95150	29/32	1 1/32	6·330	1·546	2·466	2·776	·566	83·70
98372	15/16	1 1/16	6·500	1·593	2·536	2·853	·585	83·65
101590	31/32	1 3/32	6·670	1·640	2·607	2·930	·605	83·60
104805	1	1 1/8	6·840	1·687	2·677	3·007	·625	83·55
108015	1 1/32	1 5/32	7·010	1·734	2·747	3·083	·644	83·50
111235	1 1/16	1 3/16	7·181	1·781	2·818	3·160	·664	83·46
114452	1 3/32	1 7/32	7·351	1·828	2·889	3·237	·683	83·42
117665	1 1/8	1 1/4	7·522	1·875	2·959	3·314	·703	83·38
120876	1 5/32	1 9/32	7·692	1·921	3·030	3·391	·722	83·34
124083	1 3/16	1 5/16	7·863	1·968	3·100	3·468	·742	83·30
127303	1 7/32	1 11/32	8·034	2·015	3·171	3·545	·761	83·27
130520	1 1/4	1 3/8	8·205	2·062	3·242	3·622	·781	83·24

N = Numeral appropriate to the thickness of plate and tensile strength of steel.
B = Working pressure, in pounds, per square inch.
D = *Diameter* of boiler, inside, in inches. F = *Nominal* factor of safety.

$$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$$

NUMERALS.

iveted Joints in Steel Plates having a Tensile Strength of 26, 27, 28, 29, 30, 31 and 32 tons per square inch.

se numerals are applicable to the thickness of plate which are opposite, provided the calculated percentage of the joint given opposite the same thickness in the Table immediately ding.

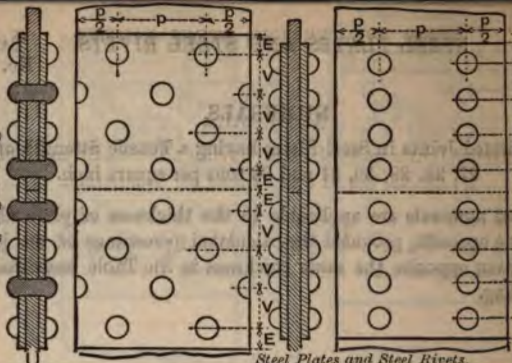
26 tons. D×B×F. N	27 tons. D×B×F. N	28 tons. D×B×F. N	29 tons. D×B×F. N	30 tons. D×B×F N	31 tons. D×B×F. N	32 tons. D×B×F. N
55469	57602	59736	61869	64002	66136	68269
58460	60708	62957	65205	67453	69702	71950
61457	63821	66185	68548	70912	73276	75640
64445	66924	69403	71881	74360	76839	79317
67434	70028	72622	75215	77809	80402	82996
70424	73133	75842	78550	81259	83967	86676
73416	76240	79064	81887	84711	87535	90358
76402	79341	82280	85218	88157	91095	94034
79392	82446	85500	88553	91607	94660	97714
82378	85546	88715	91883	95051	98220	101388
85367	88650	91934	95217	98500	101784	105067
88353	91751	95150	98548	101946	105344	108742
91345	94858	98372	101885	105398	108911	112425
94333	97961	101590	105218	108846	112474	116102
97318	101061	104805	108548	112291	116034	119777
100299	104157	108015	111872	115730	119588	123445
103289	107262	111235	115207	119180	123153	127126
106276	110364	114452	118539	122627	126714	130802
109260	113462	117665	121867	126069	130271	134474
112242	116559	120876	125193	129510	133827	138144
115219	119651	124083	128514	132946	137377	141809
118209	122756	127303	131849	136396	140942	145489
121197	125858	130520	135181	139842	144504	149165

umeral appropriate to the thickness of plate and tensile strength of steel.
orking pressure, in pounds, per square inch.
iameter of boiler, inside, in inches. F = Nominal factor of safety.

$D \times B \times F = N$ $\qquad \frac{N}{B \times F} = D$ $\qquad \frac{N}{D \times F} = B$ $\qquad \frac{N}{D \times B} = F$

Quadruple Riveted Double Butt Joints.
Zig Zag Riveting.

TABLE No. 158.



Steel Plates and Steel Rivets.

28 tons D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.	Distance between Rows of Rivets. Chain Riveting.	Thickness of Butt Straps.	Percentage of Joint.
N	T	d	p	E	V	V	T_1	
59736	9/16	11/16	4·482	1·031	1·940	1·875	·351	84·66
62957	19/32	23/32	4·648	1·078	2·015	1·937	·371	84·53
66185	5/8	3/4	4·814	1·125	2·090	2·000	·390	84·42
69403	21/32	25/32	4·981	1·171	2·166	2·062	·410	84·31
72622	11/16	13/16	5·148	1·218	2·242	2·125	·429	84·21
75842	23/32	27/32	5·316	1·265	2·318	2·187	·449	84·1[illegible]
79064	3/4	7/8	5·485	1.312	2·394	2·250	·468	84·0[illegible]
82280	25/32	29/32	5·653	1·359	2·470	2·312	·488	83·[illegible]
85500	13/16	15/16	5·822	1·406	2·547	2·375	·507	83·[illegible]
88715	27/32	31/32	5·991	1·453	2·623	2·437	·527	83[illegible]
91934	7/8	1	6·161	1·500	2·700	2·500	·546	83[illegible]
95150	29/32	1 1/32	6·330	1·546	2·776	2·562	·566	83[illegible]
98372	15/16	1 1/16	6·500	1·593	2·853	2·625	·585	83[illegible]
101590	31/32	1 3/32	6·670	1·640	2·930	2·687	·605	83[illegible]
104805	1	1 1/8	6·840	1·687	3·007	2·750	·625	83[illegible]
108015	1 1/32	1 5/32	7·010	1·734	3·083	2·812	·644	83[illegible]
111235	1 1/16	1 3/16	7·181	1·781	3·160	2·875	·664	83[illegible]
114452	1 3/32	1 7/32	7·351	1·828	3·237	2·937	·683	83[illegible]
117665	1 1/8	1 1/4	7·522	1·875	3·314	3·000	·703	83[illegible]
120876	1 5/32	1 9/32	7·692	1·921	3·391	3·062	·722	83[illegible]
124083	1 3/16	1 5/16	7·863	1·968	3·468	3·125	·742	83[illegible]
127303	1 7/32	1 11/32	8·034	2·015	3·545	3·187	·761	83[illegible]
130520	1 1/4	1 3/8	8·205	2·062	3·622	3·250	·781	83[illegible]

N = Numeral appropriate to the thickness of plate and tensile strength of steel.
B = Working pressure, in pounds, per square inch.
D = Diameter of boiler, inside, in inches. F = *Nominal* factor of safety.

$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$

NUMERALS.

For Riveted Joints in Steel Plates having a Tensile Strength of 26, 27, 28, 29, 30, 31 and 32 tons per square inch.

These numerals are applicable to the thickness of plate which they are opposite, provided the calculated percentage of the joint is as given opposite the same thickness in the Table immediately preceding.

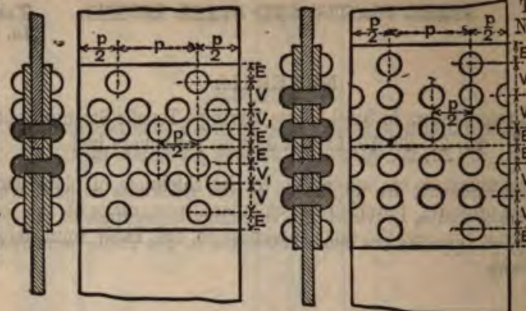
Thickness of Plates.	26 tons. D×B×F.	27 tons. D×B×F.	28 tons. D×B×F.	29 tons. D×B×F.	30 tons. D×B×F.	31 tons. D×B×F.	32 tons. D×B×F.
T	N	N	N	N	N	N	N
9/16	55469	57602	59736	61869	64002	66136	68269
19/32	58460	60708	62957	65205	67453	69702	71950
5/8	61457	63821	66185	68548	70912	73276	75640
21/32	64445	66924	69403	71881	74360	76839	79317
11/16	67434	70028	72622	75215	77809	80402	82996
23/32	70424	73133	75842	78550	81259	83967	86676
3/4	73416	76240	79064	81887	84711	87535	90358
25/32	76402	79341	82280	85218	88157	91095	94034
13/16	79392	82446	85500	88553	91607	94660	97714
27/32	82378	85546	88715	91883	95051	98220	101388
7/8	85367	88650	91934	95217	98500	101784	105067
29/32	88353	91751	95150	98548	101946	105344	108742
15/16	91345	94858	98372	101885	105398	108911	112425
31/32	94333	97961	101590	105218	108846	112474	116102
1	97318	101061	104805	108548	112291	116034	119777
1 1/32	100299	104157	108015	111872	115730	119588	123445
1 1/16	103289	107262	111235	115207	119180	123153	127125
1 3/32	106276	110364	114452	118539	122627	126714	130802
1 1/8	109260	113462	117665	121867	126069	130271	134474
1 5/32	112242	116559	120876	125193	129510	133827	138144
1 3/16	115219	119651	124083	128514	132946	137377	141809
1 7/32	118209	122756	127303	131849	136396	140942	145489
1 1/4	121197	125858	130520	135181	139842	144504	149165

N = Numeral appropriate to the thickness of plate and tensile strength of steel.
B = Working pressure, in pounds, per square inch.
D = Diameter of boiler, inside, in inches. F = *Nominal* factor of safety.

$$D \times B \times F = N \qquad \frac{N}{B \times F} = D \qquad \frac{N}{D \times F} = B \qquad \frac{N}{D \times B} = F$$

Treble Riveted Double Butt Joints, each alternate

Zig Zag Riveting. Chain Riveting.



Rivet omitted in the outer row.

TABLE No. 160.

Steel Plates and Steel Rivets.

28 tons. D×B×F.	Thickness of Plates.	Diameter of Rivets.	Pitch of Rivets.	Centre of Rivets to Edge of Plates.	Distance between Rows of Rivets. Zig Zag Riveting.		Chain Riveting.		Thickness of Butt Straps.	Percentage of Joint.
N	T	d	p	E	V	V_1	V	V_1	T_1	
73260	11/16	11/16	4·568	1·031	1·711	1·184	1·969	1·875	·522	84·95
76590	23/32	23/32	4·776	1·078	1·789	1·238	2·059	1·937	·545	84·95
79920	3/4	3/4	4·983	1·125	1·867	1·292	2·148	2·000	·569	84·95
83251	25/32	25/32	5·191	1·171	1·945	1·346	2·237	2·062	·593	84·95
86581	13/16	13/16	5·399	1·218	2·023	1·399	2·327	2·125	·617	84·95
89911	27/32	27/32	5·606	1·265	2·100	1·453	2·416	2·187	·640	84·95
93241	7/8	7/8	5·814	1·312	2·178	1·507	2·506	2·250	·664	84·95
96571	29/32	29/32	6·022	1·359	2·256	1·561	2·596	2·312	·688	84·95
99901	15/16	15/16	6·229	1·406	2·334	1·615	2·685	2·375	·712	84·95
103231	31/32	31/32	6·437	1·453	2·412	1·669	2·775	2·437	·735	84·95
106561	1	1	6·645	1·500	2·490	1·723	2·864	2·500	·759	84·95
109891	1 1/32	1 1/32	6·852	1·546	2·567	1·776	2·954	2·562	·783	84·95
113221	1 1/16	1 1/16	7·060	1·593	2·645	1·830	3·043	2·625	·807	84·95
116551	1 3/32	1 3/32	7·268	1·640	2·723	1·884	3·132	2·687	·830	84·95
119881	1 1/8	1 1/8	7·475	1·687	2·801	1·938	3·222	2·750	·854	84·95
123211	1 5/32	1 5/32	7·683	1·734	2·879	1·992	3·312	2·812	·878	84·95
126541	1 3/16	1 3/16	7·890	1·781	2·956	2·046	3·401	2·875	·901	84·95
129871	1 7/32	1 7/32	8·098	1·828	3·034	2·099	3·491	2·937	·925	84·95
133201	1 1/4	1 1/4	8·306	1·875	3·112	2·153	3·580	3·000	·949	84·95
136531	1 9/32	1 9/32	8·513	1·921	3·190	2·207	3·670	3·062	·973	84·95
139861	1 5/16	1 5/16	8·721	1·968	3·268	2·261	3·759	3·125	·996	84·95
143191	1 11/32	1 11/32	8·929	2·015	3·346	2·315	3·849	3·187	1·020	84·95
146521	1 3/8	1 3/8	9·136	2·062	3·423	2·369	3·938	3·250	1·044	84·95

N = Numeral appropriate to the thickness of plate and tensile strength of steel.
B = Working pressure, in pounds, per square inch.
D = Diameter of boiler, inside, in inches. F = *Nominal* factor of safety.

$$D\times B\times F = N \qquad \frac{N}{B\times F} = D \qquad \frac{N}{D\times F} = B \qquad \frac{N}{D\times B} = F$$

NUMERALS.

r Riveted Joints in Steel Plates having a Tensile Strength of 26, 27, 28, 29, 30, 31 and 32 tons per square inch.

These numerals are applicable to the thickness of plate which ey are opposite, provided the calculated percentage of the joint as given opposite the same thickness in the Table immediately eceding.

kness late.	26 tons. D×B×F.	27 tons. D×B×F.	28 tons. D×B×F.	29 tons. D×B×F.	30 tons. D×B×F.	31 tons. D×B×F.	32 tons. D×B×F.
T	N	N	N	N	N	N	N
/16	68027	70643	73260	75876	78492	81109	83725
/32	71119	73854	76590	79325	82060	84796	87531
/4	74211	77065	79920	82774	85628	88482	91337
/32	77304	80277	83251	86224	89197	92170	95144
/16	80396	83488	86581	89673	92765	95857	98949
/32	83488	86699	89911	93122	96333	99544	102755
/8	86580	89910	93241	96571	99901	103231	106561
/32	89673	93122	96571	100019	103468	106917	110366
/16	92765	96333	99901	103468	107036	110604	114172
/32	95857	99544	103231	106917	110604	114291	117978
	98949	102755	106561	110366	114172	117978	121784
/32	102041	105966	109891	113815	117740	121665	125589
/16	105133	109177	113221	117264	121308	125351	129395
/32	108225	112388	116551	120713	124876	129038	133201
/8	111318	115599	119881	124162	128443	132725	137006
/32	114410	118810	123211	127611	132011	136412	140812
/16	117502	122021	126541	131060	135579	140098	144618
/32	120594	125232	129871	134509	139147	143785	148424
/4	123686	128443	133201	137958	142715	147472	152229
/32	126778	131654	136531	141407	146283	151159	156035
/16	129870	134865	139861	144856	149851	154846	159841
1/32	132963	138077	143191	148304	153418	158532	163646
	136055	141288	146521	151753	156986	162219	167452

= Numeral appropriate to the thickness of plate and tensile strength of steel.
= Working pressure, in pounds, per square inch.
= Diameter of boiler, inside, in inches. F = *Nominal* factor of safety.

$D \times B \times F = N$ $\frac{N}{B \times F} = D$ $\frac{N}{D \times F} = B$ $\frac{N}{D \times B} = F$

FURNACES, PLAIN CYLINDRICAL.

Steel Plates.

The Tables No. 162 to 174, which immediately follow these remarks, are only intended for furnaces of ordinary diameters, when the length does not exceed 10 feet, and for the given thickness of plate at the head of the table. The diameter should never exceed that found in the column opposite the particular pressure. When A1 is the distinguishing letter, Table No. 175 may be used.

By the tables, if the diameter is determined, the length, thickness, and pressure can be found; the length can be found if the diameter, thickness, and pressure are determined; the pressure can be ascertained if the diameter, thickness, and length are known; and when the diameter, length, and pressure are determined, the required thickness can be found.

The numerals in each table, under each distinguishing letter, are those applicable to the circumstances of the case to which the letter refers and to the thickness of plate at the head of the table.

The distinguishing letters refer to the method adopted in constructing the furnaces, as the following will explain:—

Distinguishing Letters.		Distinguishing Letters.
A1.	Longitudinal seams welded, and the furnace *annealed afterwards*, ...	A1.
A.	Longitudinal seams double riveted, single butt straps, and holes *drilled*, ...	A.
A.	Longitudinal seams single riveted, double butt straps, and holes *drilled*, ...	A.
B.	Longitudinal seams double riveted, single butt straps, holes *punched*, and the plates *annealed afterwards*, ...	B.
B.	Longitudinal seams single riveted, double butt straps, holes *punched*, and the plates *annealed afterwards*, ...	B.
C.	Longitudinal seams single riveted, single butt straps, and holes *drilled*, ...	C.
C.	Longitudinal seams double riveted, lap joints bevelled, and holes *drilled*, ...	C.
D.	Longitudinal seams single riveted, single butt straps, holes *punched*, and the plates *annealed afterwards*, ...	D.
D.	Longitudinal seams double riveted, lap joints *not* bevelled, and holes *drilled*, ...	D.
D.	Longitudinal seams double riveted, lap joints bevelled, holes *punched*, and the plates *annealed afterwards*.	D.

ıishing ters.		Distinguishing Letters.
.	Longitudinal seams single riveted, lap joints bevelled, and holes *drilled*, ...	E.
.	Longitudinal seams double riveted, lap joints *not* bevelled, holes *punched*, and the plates *annealed afterwards*, ...	E.
.	Longitudinal seams single riveted, lap joints *not* bevelled, and holes *drilled*, ...	F.
.	Longitudinal seams single riveted, lap joints bevelled, holes *punched*, and the plates *annealed afterwards*, ...	F.
.	Longitudinal seams single riveted, lap joints *not* bevelled, holes *punched*, and the plates *annealed afterwards*, ...	G.

ching the holes is always objectionable, more particularly when tes are not very thin. If punched, the plates should be annealed they are bent.

n the foregoing it will be seen that the distinguishing letter A ference to three different methods of construction, the letter B , the letter C to two, the letter D to three, the letter E to two, ter F to two, and G to one method.

Numeral in the table applicable to the method of construction.
Length of furnace in feet (for the limits of L, see the first paragraph of these notes).
Diameter of furnace, in inches, outside.
Working pressure, in lbs. per square inch.

The *maximum* diameter in inches of a *horizontal* furnace for any ·e, if the length of the furnace, the thickness of plate, and ·e be determined, may be found by dividing the numeral in the ı applicable to the class of furnace, or method of construction, posite the given pressure, by the length of furnace in feet *plus* 1. the outside diameter in inches should not exceed $\frac{N}{L+1} = D.$

ıe thickness of the plates be $^9/_{16}$ inch, the length 10 feet, and the ·e 75 lbs., and the *horizontal* furnace is of the description to which tinguishing letter A is applicable, and it is required to determine ximum outside diameter :—

Then, in the table for $^9/_{16}$ inch steel plates (No. 172), opposite lbs., the pressure, in the column A, applicable to the case, 418, e numeral, is found, and if this be divided by 11, the length in ıt *plus* 1, the result is 38, which is the greatest outside diameter inches the furnace should be,

$$\frac{418}{10+1} = 38 = D.$$

(2) The maximum length in feet of a *horizontal* furnace for any pressure, if the diameter of the furnace and thickness of plate be determined, may be found by dividing the numeral applicable to the class of furnace or method of construction, and opposite the given pressure, by the diameter in inches, and diminishing the result by 1.

Or, the length should not exceed $\frac{N}{D} - 1 = L.$

If the thickness of the steel plates be $\frac{7}{16}$ inch, the outside diameter 30 inches, and the pressure 100 lbs., and the *horizontal* furnace is of the description to which the distinguishing letter A is applicable, and it is required to determine the greatest length:—

Then, in the table for $\frac{7}{16}$ inch steel plates (No. 168), opposite 100 lbs., the pressure in the column A, applicable to the case, 189, the numeral, is found, and if this be divided by 30, the outside diameter, the result is 6·3, which lessened by 1 equals 5·3, which is the greatest length in feet the furnace should be,

$$\text{or} \quad \frac{189}{30} = 6{\cdot}3$$

$$\text{and} \quad 6{\cdot}3 - 1 = 5{\cdot}3 = L.$$

(3) The maximum pressure for any *horizontal* furnace, if the diameter of the furnace, the thickness of plate, and the length be known, may be found by multiplying the diameter in inches by the length in feet *plus* 1, the result is the numeral which should be looked for under the distinguishing letter applicable to the class of furnace or method of construction, and opposite the numeral so arrived at the greatest pressure is found, on the left in the first column on the page,

$$\text{or} \quad D \times (L + 1) = N,$$

and the pressure found on the left of the page opposite the numeral, in the column under the distinguishing letter applicable to the case, is the greatest pressure.

If the thickness of the steel plates be $\frac{3}{8}$ inch, the outside diameter 23 inches, and the length 10 feet, and the furnace is of the description to which the distinguishing letter A is applicable, and the greatest working pressure is required to be determined:—

Then, if 23, the outside diameter, be multiplied by 11, which is the length *plus* 1, the result is 253, the numeral, and in the table for $\frac{3}{8}$ inch plate in column A applicable to the case, opposite 253, on the left of the page, 55 lbs. pressure is found, which is the greatest working pressure,

$$\text{or} \quad 23 \times (10 + 1) \text{ or } 23 \times 11 = 253 = N,$$

and opposite the numeral 253, the pressure found is 55 lbs. = B.

(4) The minimum thickness of the plate of a *horizontal* furnace, if *the pressure,* diameter, and length of furnace, and class of furnace or

ethod of construction be known, may be found by multiplying the ameter in inches by the length in feet *plus* 1, which gives the numeral, hich numeral should be looked for *opposite* the pressure in a column the tables under the distinguishing letter applicable to the class of rnace, and if such a number is not found, the nearest to it, but not lower number, is the numeral to adopt, and at the head of the table ie thickness of plate given is the least thickness,

$$\text{or} \quad D \times (L+1) = N.$$

If the outside diameter of a *horizontal* steel furnace be 40 inches, the ngth 7 feet, and the pressure 120 lbs., and the class of furnace is such the distinguishing letter A refers to, and the *minimum* thickness of late is required:—

Then, if 40, the outside diameter, be multiplied by $7+1=8$, which is the length increased by 1, the result is 320, which is practically the numeral found opposite 120, the pressure, in column A of Table No. 174; the numeral found opposite 120 lbs. only differs by 2, and such difference is of no material consequence. At the head of the table, in which 322 is found, the thickness is ⅝ inch, which is the least thickness the plates should be.

Had the numeral arrived at been much in excess of 322, then the pressure could not be so high as 120 lbs., for the length and diameter stipulated, as the tables do not include plates above ⅝ inch thick; but if the plates had been less than ⅝ inch thick, and the numeral arrived at was in excess of that found opposite the stipulated pressure in one table, then the next higher numeral, found opposite the stipulated pressure, and in a column under the distinguishing letter applicable, in a table for *thicker* plates, is the numeral to be used; for instance, if the numeral arrived at in a case be 125, and in a table opposite the stipulated pressure and under the distinguishing letter applicable to the circumstances of the case, 116 is found, and in the table for next thicker plates, opposite the stipulated pressure, and in the column under the distinguishing letter, the numeral is 136, the thickness at the head of the table in which 136 is found is the required thickness.

Furnaces which are found too weak may be materially strengthened o as to be fit for greater pressures, by fitting rings, as properly fitted ings are equivalent to shortening the length.

(5) If a furnace be *vertical*, its diameter should not exceed ·9 of that uitable for a *horizontal* one of the same dimensions in other respects nd constructed in the same manner:—

Thus, if 40 inches is the proper diameter for a *horizontal* furnace, then

$$40 \times \cdot 9 = 36 = D.$$

which is the outside diameter the *vertical* furnace should be.

(6) In finding the length of a *vertical* furnace, the appropriat numeral for a *horizontal* one of the same dimensions, and constructed in the same manner, should be multiplied by ·9 :—

Thus, if 322 be the appropriate numeral for a *horizontal* furnace and 40 inches the outside diameter,

$$\text{Then} \quad \frac{\cdot 9 \times 322}{40} - 1 \; = \; 6 \cdot 245 \; = \; \text{L},$$

which is the length the *vertical* furnace should be.

(7) In finding the pressure for a *vertical* furnace, the numeral is found by multiplying the length in feet *plus* 1, by the outside diameter in inches and by ·9. Then opposite the numeral will be found the pressure in the same way as for a *horizontal* furnace.

(8) In determining the thickness of a *vertical* furnace, having found the numeral by multiplying the length in feet, *plus* 1, by the diameter in inches, and dividing the result by ·9, the nearest numeral (but not a lower one) should be looked for opposite the pressure in the tables, and in the column under the distinguishing letter applicable to the construction of the furnace, and the thickness is that at the head of the table.

When the diameter of a *vertical* furnace does not decrease 1 in 12, instead of using the number ·9 alluded to in the former paragraphs, it should be ·85, and if the furnace is parallel it should not exceed ·8.

D=Diameter of [illegible]

L=Length of furnace in feet.

FURNACES PLAIN CYLINDRICAL.

TABLE No. 163.

Steel Plates $\frac{9}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.							Maximum Diam.*
	A1†A N	B N	C N	D N	E N	F N	G N	
lbs.								ins.
5	...	...	...	...	...	...	...	...
10	783	740	696	653	609	566	522	72
15	522	493	464	435	406	377	348	71
20	392	370	348	326	305	283	261	70
25	313	296	278	261	244	226	209	68·75
30	261	247	232	218	203	189	174	64·71
35	224	211	199	186	174	162	149	61·11
40	196	185	174	163	152	141	131	57·89
45	174	164	155	145	135	126	116	55
50	157	148	139	131	122	113	104	49·5
55	142	134	127	119	111	103	94·9	45
60	131	123	116	109	102	94·3	87	41·25
65	120	114	107	100	93·7	87	80·3	38·08
70	112	106	99·4	93·2	87	80·8	74·6	35·36
75	104	98·6	92·8	87	81·2	75·4	69·6	33
80	97·9	92·4	87	81·6	76·1	70·7	65·3	30·94
85	92·1	87	81·9	76·8	71·7	66·5	61·4	29·12
90	87	82·2	77·3	72·5	67·7	62·8	58	27·5
95	82·4	77·9	73·3	68·7	64·1	59·5	55	26·05
100	78·3	74	69·6	65·3	60·9	56·6	52·2	24·75
105	74·6	70·4	66·3	62·2	58	53·9	49·7	23·57
110	71·2	67·2	63·3	59·3	55·4	51·4	47·5	22·5
115	68·1	64·3	60·5	56·7	53	49·2	45·4	21·52
120	65·3	61·6	58	54·4	50·8	47·1	43·5	20·63
125	62·6	59·2	55·7	52·2	48·7	45·2	41·8	19·8
130	60·2	56·9	53·5	50·2	46·9	43·5	40·2	19·04
135	58	54·8	51·6	48·3	45·1	41·9	38·7	18·33
140	55·9	52·8	49·7	46·6	43·5	40·4	37·3	17·68
145	54	51	48	45	42	39	36	17·07
150	52·2	49·3	46·4	43·5	40·6	37·7	34·8	16·5
155	50·5	47·7	44·9	42·1	39·3	36·5	33·7	15·97
160	48·9	46·2	43·5	40·8	38·1	35·3	32·6	15·47

The length L should never exceed 10 ft. and $\frac{N}{D}-1$ should not be more than 10 ft.

* The diameter D should *not* be greater for any given pressure than that opposite the given pressure in this table, but *may be less.*

† When A1 is the distinguishing letter, Table No. 175 may be used when the length does not exceed 2·164 feet.

The numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

D = Diameter of furnace in inches. N = Numeral applicable to the case.

L = Length of furnace in feet. $\frac{N}{D}-1 = L.$ $\frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL.

TABLE No. 164.

Steel Plates $\frac{5}{16}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Numerals.							Maximum Diam.*
A1†A N	B N	C N	D N	E N	F N	G N	ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
645	609	573	537	501	465	430	72
483	457	430	403	376	349	322	71
387	365	344	322	301	279	258	70
322	304	286	269	251	233	215	68·75
276	261	246	230	215	199	184	64·71
242	228	215	201	188	175	161	61·11
215	203	191	179	167	155	143	57·89
193	183	172	161	150	140	129	55
176	166	156	146	137	127	117	50
161	152	143	134	125	116	107	45·83
149	140	132	124	116	107	99·2	42·31
138	130	123	115	107	99·7	92·1	39·29
129	122	115	107	100	93·1	85·9	36·67
121	114	107	101	94	87·3	80·6	34·38
114	107	101	94·8	88·5	82·1	75·8	32·35
107	101	95·5	89·5	83·5	77·6	71·6	30·56
102	96·1	90·5	84·8	79·2	73·5	67·8	28·95
96·7	91·3	85·9	80·6	75·2	69·8	64·5	27·5
92·1	87	81·8	76·7	71·6	66·5	61·4	26·19
87·9	83	78·1	73·2	68·4	63·5	58·6	25
84·1	79·4	74·7	70·1	65·4	60·7	56	23·91
80·6	76·1	71·6	67·1	62·7	58·2	53·7	22·92
77·3	73	68·8	64·5	60·2	55·9	51·6	22
74·4	70·2	66·1	62	57·8	53·7	49·6	21·15
71·6	67·6	63·7	59·7	55·7	51·7	47·7	20·37
69·1	65·2	61·4	57·5	53·7	49·9	46	19·64
66·7	63	59·3	55·6	51·9	48·2	44·4	18·97
64·5	60·9	57·3	53·7	50·1	46·5	43	18·33
62·4	58·9	55·4	52	48·5	45	41·6	17·74
60·4	57·1	53·7	50·4	47	43·6	40·3	17·19

length L should never exceed 10 ft. and $\frac{N}{D} - 1$ should not be more than 10 ft.

e diameter D should *not* be greater for any given pressure than that ite the given pressure in this table, but *may be less*.

hen A1 is the distinguishing letter, Table No. 175 may be used when the does not exceed 2·515 feet.

numeral N should always be taken from the column under the disting letter applicable to the case and opposite the given pressure.

Diameter of furnace in inches. N = Numeral applicable to the case.

Length of furnace in feet. $\frac{N}{D} - 1 = L. \quad \frac{N}{L+1} = D$

FURNACES PLAIN CYLINDRICAL.

Steel Plates $\frac{11}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressur[e] per sq. in.	Numerals.						
	A1†A N	B N	C N	D N	E N	F N	G N
lbs.							
5	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...
20	585	552	520	487	455	422	390
25	468	442	416	390	364	338	312
30	390	368	347	325	303	282	260
35	334	316	297	279	260	241	223
40	292	276	260	244	227	211	195
45	260	246	231	217	202	188	173
50	234	221	208	195	182	169	156
55	213	201	189	177	165	154	142
60	195	184	173	162	152	141	130
65	180	170	160	150	140	130	120
70	167	158	149	139	130	121	111
75	156	147	139	130	121	113	104
80	146	138	130	122	114	106	97·5
85	138	130	122	115	107	99·4	91·7
90	130	123	116	108	101	93·9	86·7
95	123	116	109	103	95·8	88·9	82·1
100	117	110	104	97·5	91	84·5	78
105	111	105	99	92·8	86·7	80·5	74·3
110	106	100	94·5	88·6	82·7	76·8	70·9
115	102	96·1	90·4	84·8	79·1	73·5	67·8
120	97·5	92·1	86·7	81·2	75·8	70·4	65
125	93·6	88·4	83·2	78	72·8	67·6	62·4
130	90	85	80	75	70	65	60
135	86·7	81·8	77	72·2	67·4	62·6	57·8
140	83·6	78·9	74·3	69·6	65	60·3	55·7
145	80·7	76·2	71·7	67·2	62·7	58·3	53·8
150	78	73·7	69·3	65	60·7	56·3	52
155	75·5	71·3	67·1	62·9	58·7	54·5	50·3
160	73·1	69·1	65	60·9	56·9	52·8	48·7

The length L should never exceed 10 ft. and $\frac{N}{D} - 1$ should not be more t[han]

* The diameter D should *not* be greater for any given pressure t[han] opposite the given pressure in this table, but *may be less*.

† When A1 is the distinguishing letter, Table No. 175 may be used [when] length does not exceed 2·867 feet.

The numeral N should always be taken from the column under t[he distin]guishing letter applicable to the case and opposite the given pressure.

D=Diameter of furnace in inches. N=Numeral applicable to the

L=Length of furnace in feet. $\frac{N}{D} - 1 = L.$ $\frac{N}{L+1} =$

FURNACES PLAIN CYLINDRICAL

Steel Plates ½ inch thick

Pressures and Numerals for Lengths and Diameters

TABLE No. 166.

Pressure	[illegible] A1a N	[illegible] N	[illegible] N	[illegible] N	[illegible] N	[illegible] N	[illegible] N	[illegible]
lbs.								lbs.
5	...	..	..	..	..	..		
10	...	..	..	..	..	..		
15	...	..	.	..				
20	...	..	.	..				
25	537	526	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	464	438	[illegible]	[illegible]	[illegible]	[illegible]	309	[illegible]
35	398	373	354	[illegible]	[illegible]	[illegible]	[illegible]	70
40	348	329	309	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45	309	292	275	258	[illegible]	[illegible]	206	[illegible]
50	278	263	248	[illegible]	[illegible]	201	[illegible]	[illegible]
55	253	239	225	[illegible]	[illegible]	[illegible]	159	[illegible]
60	232	219	206	[illegible]	[illegible]	[illegible]	[illegible]	55
65	214	202	190	179	[illegible]	155	143	50·77
70	199	189	[illegible]	166	155	144	133	47·14
75	186	175	165	155	144	134	124	44
80	174	164	155	145	135	126	116	[illegible]
85	164	155	146	136	127	118	108	38·82
90	156	146	138	129	120	112	103	36·67
95	147	138	130	122	114	106	97·7	34·74
100	139	131	124	116	108	101	92·8	33
105	133	125	118	110	103	93·8	88·4	31·43
110	127	120	113	105	98·4	91·4	84·4	30
115	121	114	108	101	94·2	87·4	80·7	28·69
120	116	110	103	96·7	90·3	83·8	77·3	27·5
125	111	106	99	92·8	86·6	80·4	74·3	26·4
130	107	101	95·2	89·3	83·3	77·3	71·4	25·38
135	103	97·4	91·7	85·9	80·2	74·5	68·8	24·44
140	99·4	93·9	88·4	82·9	77·3	71·8	66·3	23·57
145	96	90·7	85·3	80	74·7	69·3	64	22·76
150	92·8	87·7	82·5	77·3	72·2	67	61·9	22
155	89·8	84·8	79·8	74·8	69·9	64·9	59·9	21·29
160	87	82·2	77·3	72·5	67·7	62·8	58	20·63

The length L should never exceed 10 ft., and $\frac{N}{D}$ - 1 should not be more than 10 ft.

The diameter D should *not* be greater for any given pressure than that opposite the given pressure in this table, but *may be less*.

When A1 is the distinguishing letter, Table No. 175 may be used when the length does not exceed 3·218 feet.

The numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

D = Diameter of furnace in inches. N = Numeral applicable to the case.

L = Length *of furnace in feet*. $\frac{N}{D} - 1 = L$. $\frac{N}{L+1} = D$.

Steel Plates $\frac{13}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.						
	A1†A N	B N	C N	D N	E N	F N	G N
lbs.							
5	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...
25	...	...	...	..	...	...	...
30	545	514	484	454	424	393	363
35	467	441	415	389	363	337	311
40	408	386	363	340	318	295	272
45	363	343	323	303	282	262	242
50	327	309	290	272	254	236	218
55	297	281	264	248	231	215	198
60	272	257	242	227	212	197	182
65	251	237	223	209	196	182	168
70	233	220	207	195	182	169	156
75	218	206	194	182	169	157	145
80	204	193	182	170	159	148	136
85	192	182	171	160	150	139	128
90	182	171	161	151	141	131	121
95	172	162	153	143	134	124	115
100	163	154	145	136	127	118	109
105	156	147	138	130	121	112	104
110	149	140	132	124	116	107	99
115	142	134	126	118	111	103	94·7
120	136	129	121	113	106	98·3	90·8
125	131	123	116	109	102	94·4	87·1
130	126	119	112	105	97·8	90·8	83·8
135	121	114	108	101	94·1	87·4	80·7
140	117	110	104	97·3	90·8	84·3	77·8
145	113	106	100	93·9	87·6	81·4	75·1
150	109	103	96·8	90·8	84·7	78·7	72·6
155	105	99·6	93·7	87·8	82	76·1	70·3
160	102	96·4	90·8	85·1	79·4	73·8	68·1

The length L should never exceed 10 ft., and $\frac{N}{D}-1$ should not be more tha

* The diameter D should *not* be greater for any given pressure tha opposite the given pressure in this table, but *may be less.*

† When A1 is the distinguishing letter, Table No. 175 may be used wh length does not exceed 3·57 feet.

The numeral N should always be taken from the column under the guishing letter applicable to the case and opposite the given pressure.

D=*Diameter* of furnace in inches. N=Numeral applicable to the c

L=*Length* of furnace in feet. $\frac{N}{D}-1 = L.$ $\frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL.

Table No. 168.

Steel Plates $\frac{7}{16}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Numerals.							Maximum Diam.*
A1†A N	B N	C N	D N	E N	F N	G N	ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
541	511	481	451	421	391	361	72
474	447	421	395	368	342	316	71
421	398	374	351	328	304	281	70
379	358	337	316	295	274	253	68·75
345	325	306	287	268	249	230	64·71
316	298	281	263	246	228	211	61·11
292	275	259	243	227	211	194	57·89
271	256	241	226	211	196	180	55
253	239	225	211	197	182	168	51·33
237	224	211	197	184	171	158	48·13
223	211	198	186	173	161	149	45·29
211	199	187	175	164	152	140	42·78
199	188	177	166	155	144	133	40·53
189	179	168	158	147	137	126	38·5
180	170	160	150	140	130	120	36·67
172	163	153	144	134	124	115	35
165	156	146	137	128	119	110	33·48
158	149	140	132	123	114	105	32·08
152	143	135	126	118	109	101	30·8
146	138	130	121	113	105	97·2	29·62
140	133	125	117	109	101	93·6	28·52
135	128	120	113	105	97·8	90·2	27·5
131	123	116	109	102	94·4	87·1	26·55
126	119	112	105	98·3	91·2	84·2	25·67
122	115	109	102	95·1	88·3	81·5	24·84
118	112	105	98·7	92·1	85·5	79	24·06

e length L should never exceed 10 ft., and $\frac{N}{D} - 1$ should not be more than 10 ft.

he diameter D should *not* be greater for any given pressure than that site the given pressure in this table, but *may be less*.

Vhen A1 is the distinguishing letter, Table No. 175 may be used when the h does not exceed 3·921 feet.

e numeral N should always be taken from the column under the distinguing letter applicable to the case and opposite the given pressure.

=Diameter of furnace in inches. N = Numeral applicable to the case.

=Length of *furnace in feet*. $\frac{N}{D} - 1 = L. \quad \frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL.

TABLE No. 169.

Steel Plates $\frac{15}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.							Maximum Diam.*
	A1†A N	B N	C N	D N	E N	F N	G N	
lbs.								ins.
5	...	...	...	...	...	...	...	..
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...
40	544	514	483	453	423	393	363	72
45	483	457	430	403	376	349	322	71
50	435	411	387	363	338	314	290	70
55	396	374	352	330	308	286	264	68·75
60	363	342	322	302	282	262	242	64·71
65	335	316	297	279	260	242	223	61·11
70	311	293	276	259	242	224	207	57·89
75	290	274	258	242	226	209	193	55
80	272	257	242	227	211	196	181	51·56
85	256	242	227	213	199	185	171	48·53
90	242	228	215	201	188	175	161	45·83
95	229	216	204	191	178	165	153	43·42
100	218	205	193	181	169	157	145	41·25
105	207	196	184	173	161	150	138	39·29
110	198	187	176	165	154	143	132	37·5
115	189	179	168	158	147	137	126	35·87
120	181	171	161	151	141	131	121	34·38
125	174	164	155	145	135	126	116	33
130	167	158	149	139	130	121	112	31·73
135	161	152	143	134	125	116	107	30·56
140	155	147	138	129	121	112	104	29·46
145	150	142	133	125	117	108	100	28·45
150	145	137	129	121	113	105	96·7	27·5
155	140	133	125	117	109	101	93·6	26·61
160	136	128	121	113	106	98·2	90·6	25·78

The length L should never exceed 10 ft., and $\frac{N}{D}-1$ should not be more than 10 ft.

* The diameter D should *not* be greater for any given pressure than that opposite the given pressure in this table, but *may be less*.

† When A1 is the distinguishing letter, Table No. 175 may be used when the length does not exceed 4·273 feet.

The numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

D = *Diameter of furnace in inches.* N = Numeral applicable to the case.

L = *Length of furnace in feet.* $\frac{N}{D}-1 = L.$ $\frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL. Steel Plates $\frac{1}{2}$ inch thick.

ressures and Numerals for Lengths and Diameters.

TABLE No. 170.

†A N	B N	C N	D N	E N	F N	G N	Maximum Diam.*
							ins.
.	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...
.	...	...	...	...	...	...	..
.	...	...	...	...	...	...	...
.	...	...	...	...	...	...	...
0	519	489	458	428	397	367	72
5	468	440	413	385	358	330	71
0	425	400	375	350	325	300	70
3	390	367	344	321	298	275	68·75
1	360	338	317	296	275	254	64·71
4	334	314	295	275	255	236	61·11
0	312	293	275	257	238	220	57·89
9	292	275	258	241	223	206	55
1	275	259	243	226	210	194	51·76
5	260	244	229	214	199	183	48·89
1	246	232	217	203	188	174	46·32
8	234	220	206	193	179	165	44
6	223	210	196	183	170	157	41·9
5	213	200	187	175	162	150	40
5	203	191	179	167	155	143	38·26
6	195	183	172	160	149	138	36·67
8	187	176	165	154	143	132	35·2
0	180	169	159	148	138	127	33·85
3	173	163	153	143	132	122	32·59
7	167	157	147	138	128	118	31·43
1	161	152	142	133	123	114	30·34
5	156	147	138	128	119	110	29·33
0	151	142	133	124	115	106	28·39
5	146	138	129	120	112	103	27·5

th L should never exceed 10 ft., and $\frac{N}{D}-1$ should not be more than 10 ft.

ameter D should *not* be greater for any given pressure than that ie given pressure in this table, but *may be less.*

A1 is the distinguishing letter, Table No. 175 may be used when the s not exceed 4·625 feet.

ieral N should always be taken from the column under the distin- tter applicable to the case and opposite the given pressure.

neter of furnace in inches. N = Numeral applicable to the case.

th of furnace in feet. $\frac{N}{D}-1 = L.$ $\frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL.

Steel Plates $\frac{17}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals. A1†A N	B N	C N	D N	E N	F N	G N	Maximum Diam.*
lbs.								ins.
5	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...
50	559	528	497	466	435	404	373	72
55	508	480	452	423	395	367	339	71
60	466	440	414	388	362	336	310	70
65	430	406	382	358	334	310	287	68·75
70	399	377	355	333	310	288	266	64·71
75	373	352	331	310	290	269	248	61·11
80	349	330	310	291	272	252	233	57·80
85	329	310	292	274	256	237	219	55
90	310	293	276	259	241	224	207	51·94
95	294	278	261	245	229	212	196	49·21
100	279	264	248	233	217	202	186	46·75
105	266	251	237	222	207	192	177	44·52
110	254	240	226	212	198	183	169	42·5
115	243	229	216	202	189	175	162	40·65
120	233	220	207	194	181	168	155	38·96
125	224	211	199	186	174	161	149	37·4
130	215	203	191	179	167	155	143	35·96
135	207	195	184	172	161	149	138	34·63
140	200	188	177	166	155	144	133	33·39
145	193	182	171	161	150	139	128	32·24
150	186	176	166	155	145	135	124	31·17
155	180	170	160	150	140	130	120	30·16
160	175	165	155	146	136	126	116	29·22

The length L should never exceed 10 ft., and $\frac{N}{D} - 1$ should not be more than 10 ft.

* The diameter D should *not* be greater for any given pressure than that opposite the given pressure in this table, but *may be less.*

† When A1 is the distinguishing letter, Table No. 175 may be used when the length does not exceed 4·976 feet.

The numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

D=*Diameter* of furnace in inches. N=Numeral applicable to the case.

L=*Length* of furnace in feet. $\frac{N}{D} - 1 = L$. $\frac{N}{L+1} = D$.

FURNACES PLAIN CYLINDRICAL. TABLE No. 172.

Steel Plates $\frac{9}{16}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Numerals. A1†A N	B N	C N	D N	E N	F N	G N	Maximum Diam.* ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
570	538	506	475	443	411	380	72
522	493	464	435	406	377	348	71
482	455	428	402	375	348	321	70
447	423	398	373	348	323	298	68·75
418	394	371	348	325	302	278	64·71
392	370	348	326	305	283	261	61·11
369	348	328	307	287	266	246	57·89
348	329	309	290	271	251	232	55
330	311	293	275	256	238	220	52·10
313	296	278	261	244	226	209	49·5
298	282	265	249	232	215	199	47·14
285	269	253	237	221	206	190	45
272	257	242	227	212	197	182	43·04
261	247	232	218	203	189	174	41·25
251	237	223	209	195	181	167	39·6
241	228	214	201	187	174	161	38·08
232	219	206	193	180	168	155	36·67
224	211	199	186	174	162	149	35·36
216	204	192	180	168	156	144	34·14
209	197	186	174	162	151	139	33
202	191	180	168	157	146	135	31·94
196	185	174	163	152	141	131	30·94

…length L should never exceed 10 ft., and $\frac{N}{D}-1$ should not be more than 10 ft.

…he diameter D should *not* be greater for any given pressure than that …site the given pressure in this table, but *may be less*.

…When A1 is the distinguishing letter, Table No. 175 may be used when the …h does not exceed 5·328 feet.

…numeral N should always be taken from the column under the distin…ing letter applicable to the case and opposite the given pressure.

…=Diameter of furnace in inches. N = Numeral applicable to the case.

…=Length of furnace in feet. $\frac{N}{D}-1 = L.$ $\frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL.

Steel Plates $\frac{19}{32}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Pressure per sq. in.	Numerals.							Maxi-
	Al†A N	B N	C N	D N	E N	F N	G N	
lbs.								
5	...	...	...	...	...	...	...	
10	...	...	...	...	...	...	...	
15	...	...	...	...	...	...	...	
20	...	...	...	...	...	...	...	
25	...	...	...	...	...	...	...	
30	...	...	...	...	...	...	...	
35	...	...	...	...	...	...	...	
40	...	...	...	...	...	...	...	
45	...	...	...	...	...	...	...	
50	...	...	...	...	...	...	...	
55	...	...	...	...	...	...	...	
60	582	549	517	485	452	420	388	72
65	537	507	477	447	418	388	358	71
70	499	471	443	415	388	360	332	70
75	465	439	414	388	362	336	310	68
80	436	412	388	364	339	315	291	64
85	411	388	365	342	319	297	274	61
90	388	366	345	323	302	280	259	57
95	367	347	327	306	286	265	245	55
100	349	330	310	291	271	252	233	52
105	332	314	295	277	259	240	222	49
110	317	300	282	264	247	229	212	47
115	303	287	270	253	236	219	202	45
120	291	275	259	242	226	210	194	43
125	279	264	248	233	217	202	186	41
130	268	254	239	224	209	194	179	40
135	259	244	230	215	201	187	172	38
140	249	235	222	208	194	180	166	37
145	241	227	214	201	187	174	160	36
150	233	220	207	194	181	168	155	34
155	225	213	200	188	175	163	150	33
160	218	206	194	182	170	158	145	32

The length L should never exceed 10 ft., and $\frac{N}{D} - 1$ should not be more than

* The diameter D should *not* be greater for any given pressure than opposite the given pressure in this table, but *may be less*.

† When Al is the distinguishing letter, Table No. 175 may be used when length does not exceed 5·679 feet.

The numeral N should always be taken from the column under the di guishing letter applicable to the case and opposite the given pressure.

D = *Diameter* of furnace in inches. N = Numeral applicable to the case

L = *Length* of furnace in feet. $\frac{N}{D} - 1 = L. \quad \frac{N}{L+1} = D.$

FURNACES PLAIN CYLINDRICAL.

TABLE No. 174.

Steel Plates $\frac{5}{8}$ inch thick.

Pressures and Numerals for Lengths and Diameters.

Numerals.							Maximum Diam.*
A1†A N	B N	C N	D N	E N	F N	G N	
							ins.
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
595	562	529	496	463	430	397	72
552	522	491	460	430	399	368	71
516	487	458	430	401	372	344	70
483	457	430	403	376	349	322	68·75
455	430	404	379	354	329	303	64·71
430	406	382	358	334	310	286	61·11
407	384	362	339	317	294	271	57·89
387	365	344	322	301	279	258	55
368	348	327	307	286	266	246	52·38
352	332	313	293	273	254	234	50
336	318	299	280	262	243	224	47·83
322	304	286	269	251	233	215	45·83
309	292	275	258	241	223	206	44
297	281	264	248	231	215	198	42·31
286	271	255	239	223	207	191	40·74
276	261	246	230	215	199	184	39·29
267	252	237	222	207	193	178	37·93
258	243	229	215	201	186	172	36·67
249	236	222	208	194	180	166	35·48
242	228	215	201	188	175	161	34·38

e length L should never exceed 10 ft., and $\frac{N}{D} - 1$ should not be more than 10 ft.

The diameter D should not be greater for any given pressure than that site the given pressure in this table, but *may be less.*

When A1 is the distinguishing letter, Table No. 175 may be used when the th does not exceed 6·031 feet.

e numeral N should always be taken from the column under the distinguishing letter applicable to the case and opposite the given pressure.

=Diameter of furnace in inches. N=Numeral applicable to the case.

=Length of furnace in feet. $\frac{N}{D} - 1 = L.$ $\frac{N}{L+1} = D.$

FURNACES WITH FLANGED JOINTS.

Steel Plates from ¼ inch to ⅝ inch thick.

Following these notes is a table specially intended for furnaces made of rings welded longitudinally and flanged at the ends, and, when there is more than one ring, riveted together so as to form a complete furnace, and for furnaces whose length is equal to or shorter than that given opposite the thickness being dealt with, and found in the column "Maximum Lengths for Thickness."

The table which immediately follows these remarks is only intended for furnaces when the length or the distance between the centres of flanges of the rings, when they are made of more than one ring, does not exceed that given in the column headed "Maximum Lengths for Thickness"; but when the length or the distance between the rings exceeds that given, the pressure or other particulars should be found from the Tables No. 162 to 174.

N = Numeral for pressure.
C = Constant for thickness.
D = Diameter of furnace, in inches, outside.
l = Length or distance between centres of flanges, in inches.
B = Working pressure, in lbs. per square inch.

$$\frac{C - l}{N} = D.$$

$$C - ND = l.$$

$$ND + l = C.$$

$$\frac{C - l}{D} = N.$$

(1) The maximum diameter a furnace should be for a given working pressure, if the thickness of steel plate and the length or the distance, in inches, between the centres of the flanges be known, may be found by subtracting the length or the distance between the centres of flanges, in *inches*, from the thickness constant opposite the *given* thickness, and dividing the result by the numeral opposite the *given* pressure; or, the diameter should not exceed $\frac{C - l}{N}$.

If the thickness of the steel plates of a furnace be $\frac{5}{16}$ inch, the length or the distance between the centres of flanges 24 inches, and the pressure required 150 lbs., and the maximum diameter has to be determined:—

Then, if 24, the length or distance, in inches, between the centres of flanges be subtracted from 177·843, the constant f[ound] *opposite* the thickness, and the remainder divided by 3·4517,

numeral found opposite the pressure, 150, the result is the maximum outside diameter the furnace should be,

$$\text{or} \quad \frac{177 \cdot 843 - 24}{3 \cdot 4517} = 44 \cdot 57 = D.$$

or, say, $44\frac{9}{16}$ inches.

(2) The maximum length or the distance, in inches, between the centres of the flanges of a furnace can be determined if the working pressure, thickness of steel plates, and diameter are known, by multiplying the numeral opposite the given pressure by the diameter, and subtracting the product from the thickness constant opposite the given thickness; or the length, or distance, in inches, between the centres of flanges should not exceed $C - ND$.

If the working pressure is required to be 150 lbs., the thickness of the steel plate $\frac{9}{16}$ inch, and the outside diameter $44\frac{9}{16}$ inches, and the maximum length, or distance, in inches, between the centres of flanges has to be determined :—

Then, if 3·4517, the numeral found opposite the pressure, 150, be multiplied by 44·56, the diameter, and the product subtracted from 177·843, the constant found opposite the thickness, $\frac{9}{16}$, the remainder is the maximum length, or distance, in inches, between the centres of the flanges,

$$\text{or} \quad 3 \cdot 4517 \times 44 \cdot 56 = 153 \cdot 8077,$$

$$\text{and} \quad 177 \cdot 843 - 153 \cdot 807 = 24 \cdot 036 = l,$$

or the maximum length should be, say, 24 inches.

(3) The minimum thickness of steel plates of a furnace can be determined if the working pressure, diameter, and length, or distance, in inches, between the centres of the flanges be known, by adding the length or distance, in inches, between the centres of the flanges to the product of the diameter and the numeral opposite the given pressure; or the thickness constant should not exceed $ND + l$.

If the working pressure is required to be 150 lbs., the outside diameter $44\frac{9}{16}$ inches, and the length, or distance between the centres of flanges, 24 inches, and the minimum thickness of the steel plate has to be determined :—

Then, if 24, the length, be added to the product of 3·4517, the numeral found opposite 150, the working pressure, and 44·56, the diameter, the result is 177·80, which is practically the constant found opposite $\frac{9}{16}$, the thickness,

$$\text{or} \quad 3 \cdot 4517 \times 44 \cdot 56 + 24 = 177 \cdot 80 = C.$$

which gives $\frac{9}{16}$ inch, the thickness of the plate.

(4) The working pressure for a furnace made of steel plates, if the thickness, diameter, and length, or distance, in inches, between the

centres of the flanges is known, may be found opposite the numeral obtained by subtracting the length, in inches, from the thickness constant opposite the given thickness, and dividing by the diameter; or the numeral should not be greater than $\frac{C-l}{D}$.

If the thickness of the steel plate be $\frac{9}{16}$ inch, the outside diameter 44·56 inches, and the length or distance between the centres of the flanges 24 inches, and the working pressure is required to be determined :—

Then, if 24, the length or distance, in inches, between the centres of the flanges, be subtracted from 177·84, the constant opposite $\frac{9}{16}$, the thickness, and the remainder divided by 44·56, the diameter, the result is the numeral opposite which the working pressure is found,

$$\text{or} \quad 177{\cdot}84 - 24 = 153{\cdot}84$$

$$\text{and} \quad \frac{153{\cdot}84}{44{\cdot}56} = 3{\cdot}45 = \text{N.}$$

and opposite 3·45, the numeral, the pressure is 150 = B.

When furnaces are made with flanged joints, it is well to have the radius of the flange on the fire side about 1·5 inch.

The flanges should be kept as near the original thickness of the plate as is practicable, and after all heating, welding, and flanging are completed, the lengths should be efficiently annealed before being riveted. If there are any signs of defects in the flanging, the defective length should not on any account be used.

The distance between the edges of the rivet holes and the edges of the flange should not be less than the diameter of the rivet. The rivets should be of good size, the diameter at least $\frac{3}{8}$ inch more than the thickness of the plates, and the heads should not be too large. The depth of the strip or ring between the flanges should not be less than three times the diameter of the rivets, and the thickness may be about one-half the thickness of the furnace plates. To make a first-class job the ring should be turned.

The holes in the flanges should be drilled, but when not drilled in place they should be drilled sufficiently less in diameter to ensure that, when rimered out, fair and perfect holes are formed. It is advisable to have a little taper in the holes in each flange; this will allow the heads of the rivets to be kept of moderate size.

Furnaces with flanged joints, or those well known as Adamson's joints or seams, or sometimes as "coxcomb" joints, are by no means a new idea, as they have for a long period been used successfully in land boilers, but to a more limited extent in marine boilers than they might have been with advantage. It is not improbable, with the improved appliances now available for making these joints, more *particularly* when good mild steel plates are used, that they may in

he future be more frequently seen in modern marine boilers constructed for high pressures, although it is not known that they are the favourite furnace for marine boilers at present, except with one well-known firm of Marine Engineers, and in the opinion of that firm they are the best description of furnace that can be adopted. Whether this be so or not, they are worthy of being considered one of the descriptions of furnaces which, if properly constructed and well made, are serviceable in the modern high pressure marine boiler, and had they been more generally used in land boilers there would have been fewer collapses of furnaces.

FURNACES WITH FLANGED JOINTS.

Steel Plates from $\frac{1}{4}$ inch to $\frac{5}{8}$ inch thick.

Pressure per sq. in.	Pressure Numerals.
lbs.	N.
5	...
10	...
15	...
20	...
25	...
30	...
35	...
40	...
45	1·0355113
50	1·1505681
55	1·265625
60	1·3806818
65	1·4957386
70	1·6107954
75	1·7258522
80	1·8409090
85	1·9559659
90	2·0710227
95	2·1860795
100	2·3011363
105	2·4161931
110	2·53125
115	2·6463068
120	2·7613636
125	2·8764204
130	2·9914772
135	3·1065340
140	3·2215909
145	3·3366477
150	3·4517045
155	3·5667613
160	3·6818181

Constants and Maximum Lengths for the Thicknesses which they are opposite.		
Thickness.	Constants.	*Maximu Lengths f Thickness inches
Inches.	C	l
$\frac{1}{4}$	72·375	21·75
$\frac{9}{32}$	82·921875	25·96
$\frac{5}{16}$	93·46875	30·18
$\frac{11}{32}$	104·015625	34·40
$\frac{3}{8}$	114·5625	38·62
$\frac{13}{32}$	125·109375	42·84
$\frac{7}{16}$	135·65625	47·06
$\frac{15}{32}$	146·203125	51·28
$\frac{1}{2}$	156·75	55·5
$\frac{17}{32}$	167·296875	59·71
$\frac{9}{16}$	177·84375	63·93
$\frac{19}{32}$	188·390625	68·15
$\frac{5}{8}$	198·9375	72·37

* The lengths opposite the thickness in each case are the maximum leng in inches, between the centres of the flanges, for which the Tables should used. When the length exceeds that opposite the given thickness then pressure may be found from the Tables Nos. 162 to 174.

N = Pressure numeral. C = Thickness constant. D = Diameter, outside, in inc
l = Length between centres of flanges, in inches.

$$\frac{C-l}{N} = D \quad C-ND = l \quad ND+l = C. \quad \frac{C-l}{D} = N$$

FURNACES, CORRUGATED, CYLINDRICAL.

Steel plates from ¼ inch to ⅝ inch thick.

By the Tables Nos. 176 to 177, immediately following these remarks, the maximum diameter, the working pressure, and the thickness of the plate can be determined when the plates of which the furnaces are made are of the best mild steel.

The tables are only intended for furnaces which are machine made, and the pitch of the corrugations 6 inches, the depth from top of corrugation outside to bottom of corrugation inside not less than 2 inches, and the plain parts at the ends not more than 6 inches in length. When the corrugations are not made by machine, the working pressure should be less than that found by the tables, as furnaces, when they are not corrugated by a machine, are not so reliable.

The mean diameter for the purpose of determining the pressure or thickness is half the sum of the outside diameters, the one being that measured from the top of the corrugations, the other from the bottom of the corrugations; or, the sum of the maximum and minimum diameters inside, *plus* four times the thickness of the plate, divided by two, equals the mean diameter.

D = Mean diameter, in inches.
T = Thickness, in inches.
B = Working pressure in lbs. per square inch.

The maximum mean diameter, in inches, to which a corrugated furnace should be made, if constructed of the best mild steel plates, if the thickness of the plate and the working pressure be determined, is found in the column under the given thickness of plate and opposite the given pressure; or if the pressure and diameter be determined, the thickness the plate should be, is found at the head of the column above the given diameter which is found opposite the given presssure; or the pressure for a given thickness and diameter is that opposite the given diameter which is in the column under the given thickness.

If the pressure is required to be 160 lbs. and the thickness of the steel plate is $\frac{9}{16}$ inch, and the maximum mean diameter is required:—

Then, opposite 160 lbs., the pressure, and in the column under $\frac{9}{16}$ inch, the thickness, 43·94 is found, which is the mean diameter in inches, or say

$$44 = D.$$

If the pressure is required to be 160 lbs., and the mean diameter 41·5 inches, and the thickness of the steel plate has to be determined:—

Then, *opposite* 160 lbs., the pressure, 41·5, the diameter, is

found in the column under $^{17}/_{32}$ inch, which is the minimum thickness the steel plate should be,

$$^{17}/_{32} \text{ inch} = T.$$

If the working pressure has to be determined when the thickness of the steel plate is ½ inch, and the mean diameter 41⅝ inches :—

Then, in the column under ½ inch, the thickness, 41·66 (which is practically 41⅝), the diameter, is found, and opposite it the pressure is 150 lbs., which is the maximum working pressure in lbs.,

$$150 = B.$$

The corrugated furnace to which these remarks refer is generally known as Fox's furnace, and it has been very extensively used for a good many years. When pressures in *marine* boilers were getting up to about, say, 100 lbs., these furnaces were launched into the market with considerable success, and became the furnace generally fitted in marine boilers, when high pressures were required; and, as the pressures gradually crept up to what they now are, this furnace has kept its own against other descriptions, and become the one almost universally used. Considering that it is estimated that nearly 18000 have been made for marine boilers, and about 9000 for land boilers, in this and other countries, during the last 10½ years, it may be considered to have had its share of patronage; but while the corrugated furnace has decided advantages over others, had not the manufacturers wisely taken to making it of steel, the corrugated furnace would never have become so universally adopted. Up to this time, it is not known that any serious casualty has resulted from the collapse of a corrugated furnace, although some may have "come down;" but when this has been the case, the plates have, it is believed, always been overheated, due to dirt or other easily assigned cause, not attributable to defects in the furnace; and such deformations as have taken place would have been of a much more serious nature, had the furnace been plain instead of corrugated. The furnace is well known, and Samson Fox, the patentee, may well be contented with the success he has achieved in reputation, and probably in a pecuniary sense; nevertheless, it is thought that there is still a good deal of vitality in the same description of furnace, and possibly its special advantages may yet, if desired, be improved on, and so give it new life to compete successfully with any that may come into the market against it.

FURNACES, CORRUGATED, CYLINDRICAL.

Table No. 176.

Steel Plates from ¼ inch to 7/16 inch thick.

Pressures and Diameters when *Machine* made.

Thicknesses and Diameters.*						
¼ in.	9/32 in.	5/16 in.	11/32 in.	⅜ in.	13/32 in.	7/16 in.
Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
78·12	...	...	...	...	...	...
69·44	78·12	...	...	...	...	...
62·5	70·31	78·12	...	...	...	...
56·81	63·92	71·02	78·12	...	...	...
52·08	58·59	65·10	71·61	78·12	...	...
48·07	54·08	60·09	66·10	72·11	78·12	...
44·64	50·22	55·80	61·38	66·96	72·54	78·12
41·66	46·87	52·08	57·29	62·5	67·70	72·91
39·06	43·94	48·82	53·71	58·59	63·47	68·35
36·76	41·36	45·95	50·55	55·14	59·74	64·33
34·72	39·06	43·40	47·74	52·08	56·42	60·76
32·89	37·0	41·11	45·23	49·34	53·45	57·56
31·25	35·15	39·06	42·96	46·87	50·78	54·68
29·76	33·48	37·2	40·92	44·64	48·36	52·08
28·40	31·96	35·51	39·06	42·61	46·16	49·71
27·17	30·57	33·96	37·36	40·76	44·15	47·55
26·04	29·29	32·55	35·80	39·06	42·31	45·57
25·0	28·12	31·25	34·37	37·5	40·62	43·75
24·03	27·04	30·04	33·05	36·05	39·06	42·06
23·14	26·04	28·93	31·82	34·72	37·61	40·50
22·32	25·11	27·90	30·69	33·48	36·27	39·06
21·55	24·24	26·93	29·63	32·32	35·02	37·71
20·83	23·43	26·04	28·64	31·25	33·85	36·45
20·16	22·68	25·20	27·72	30·24	32·76	35·28
19·53	21·97	24·41	26·85	29·29	31·73	34·17

The diameter is the *mean* diameter, which is half the sum of outside diameters, the one being that measured from the top of corrugations, the other from the bottom of the corrugations.

Steel Plates from $^{15}/_{32}$ inch to ⅝ inch thick.
Pressures and Diameters when *Machine* made.

Pressure per square inch.	Thicknesses and Diameters.*					
	$^{15}/_{32}$ in.	½ in.	$^{17}/_{32}$ in.	$^{9}/_{16}$ in.	$^{19}/_{32}$ in.	⅝ in.
	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.
lbs. 5	...	...	...	...	...	...
10	...	...	...	...	...	...
15	...	...	...	...	...	...
20	...	...	...	...	...	...
25	...	...	...	...	...	...
30	...	...	...	...	...	...
35	...	...	...	...	...	...
40	...	...	...	...	...	...
45	...	...	...	...	...	...
50	...	...	...	...	...	...
55	...	...	...	...	...	...
60	...	...	...	...	...	...
65	...	...	...	...	...	...
70	...	...	...	...	...	...
75	78·12	...	...	...	...	...
80	73·24	78·12	...	...	...	...
85	68·93	73·52	78·12	...	...	...
90	65·10	69·44	73·78	78·12	...	...
95	61·67	65·78	69·90	74·01	78·12	...
100	58·59	62·5	66·40	70·31	74·21	78·12
105	55·8	59·52	63·24	66·96	70·68	74·40
110	53·26	56·81	60·36	63·92	67·47	71·02
115	50·95	54·34	57·74	61·14	64·53	67·93
120	48·82	52·08	55·33	58·59	61·84	65·10
125	46·87	50·0	53·12	56·25	59·37	62·5
130	45·07	48·07	51·08	54·08	57·09	60·09
135	43·4	46·29	49·18	52·08	54·97	57·87
140	41·85	44·64	47·43	50·22	53·01	55·8
145	40·4	43·1	45·79	48·49	51·18	53·87
150	39·06	41·66	44·27	46·87	49·47	52·08
155	37·8	40·32	42·84	45·36	47·88	50·4
160	36·62	39·06	41·5	43·94	46·38	48·82

* The diameter is the *mean* diameter, which is half the sum of the outside diameters, the one being that measured from the top of *the corrugations*, the other from the bottom of the corrugations.

FURNACES WITH RIBBED PROJECTIONS, GROOVED INSIDE.

Steel Plates from ¼ inch to ⅝ inch thick.

y the Tables Nos. 178 and 179 which immediately follow these arks, the maximum diameter, the working pressure, and the thick- of plate can be determined when the furnace plates are of the best d steel.

he tables are only intended for furnaces when the ribs and grooves formed by rolling and when the height of the ribs is not less than s inch above the plain part, the depth of the grooves not more n ¾ inch, the length between the centres of the ribs not over 9 es, and the length of the plain part at the end not more than 6 es.

he diameter for the purpose of determining the pressure is the out- diameter, measured over the plain parts between the centre of the , or projections; or the inside diameter of the plain parts *plus* twice thickness of the plain parts.

D = Diameter, in inches.
T = Thickness of plate, in inches.
B = Working pressure, in lbs. per square inch.

he maximum outside diameter, in inches, which a ribbed and oved furnace should be when made of mild steel plate of the best lity if the thickness and pressure be determined, is found in the mn under the thickness of plate and opposite the given working ssure; or if the pressure and diameter be determined, the thickness which the plate should be made is found at the head of the column ve the given diameter which is found opposite the given pressure; or pressure for a given thickness and a given diameter is that opposite given diameter which is in the column under the given thickness.

f the pressure is required to be 125 lbs. and the thickness of the tes $\frac{9}{16}$ inch, and the outside diameter has to be determined :—

Then, opposite 125 lbs., the pressure, and in the column under $\frac{9}{16}$ inch, the thickness, 49·5 is found, which is the maximum diameter, in inches,

$$49\tfrac{1}{2} = D.$$

f the pressure is required to be 155 lbs., and the diameter out- 35½ inches, and the thickness the plate should be has to be rmined :—

Then, opposite 155 lbs., the pressure, 35·48, which is practically 35½, the diameter is found in the column under ½ inch, which is the minimum thickness the steel plate should be,

$$\tfrac{1}{2}\text{ inch} = T.$$

the working pressure has to be determined when the thickness of plate is ⅝ *inch, and* the outside diameter is 43 inches :—

Then, in the column under ⅝ inch, the thickness, 42·96, which is practically 43, the diameter is found, and opposite it the pressure is 160 lbs., which is the maximum working pressure,

$$160 = B.$$

The ribbed and grooved furnace to which the previous remarks refer is known as Brown's furnace or Purvis's patent. The particular form of rib and groove may not have been adopted until made by Messrs John Brown & Co., and they have not been very long in the market, but about 2000 have been manufactured for use in this and other countries. They may be considered to be on their trial, as they have hardly been long enough in use to ensure that they possess such good qualities as to make them the furnace of the future; however, their progress up to the present time must be encouraging both to patentee and manufacturer.

FURNACES WITH RIBBED PROJECTIONS, GROOVED INSIDE. TABLE No. 178.

Steel Plates from $\frac{1}{4}$ inch to $\frac{7}{16}$ inch thick.

Pressures and Diameters.*

Thicknesses and Diameters.†						
¼ in.	9/32 in.	5/16 in.	11/32 in.	⅜ in.	13/32 in.	7/16 in.
Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
...	...	...	...	...	...	...
68·75	...	...	...	...	...	...
61·11	68·75	...	...	...	...	...
55	61·87	68·75	...	...	...	...
50	56·25	62·5	68·75	...	...	...
45·83	51·56	57·29	63·02	68·75	...	...
42·30	47·59	52·88	58·17	63·46	68·75	...
39·28	44·19	49·10	54·01	58·92	63·83	68·75
36·66	41·25	45·83	50·41	55	59·58	64·16
34·37	38·67	42·96	47·26	51·56	55·85	60·15
32·35	36·39	40·44	44·48	48·52	52·57	56·61
30·55	34·37	38·19	42·01	45·83	49·65	53·47
28·94	32·56	36·18	39·80	43·42	47·03	50·65
27·5	30·93	34·37	37·81	41·25	44·68	48·12
26·19	29·46	32·73	36·01	39·28	42·55	45·83
25	28·12	31·25	34·37	37·5	40·62	43·75
23·91	26·90	29·89	32·88	35·86	38·85	41·84
22·91	25·78	28·64	31·51	34·37	37·23	40·10
22	24·75	27·5	30·25	33	35·75	38·5
21·15	23·79	26·44	29·08	31·73	34·37	37·01
20·37	22·91	25·46	28	30·55	33·10	[illegible]
19·64	22·09	24·55	27	29·46	31·91	[illegible]
18·96	21·33	23·70	26·07	28·44	30·81	[illegible]
18·33	20·62	22·91	25·20	27·5	29·79	[illegible]
17·74	19·95	22·17	24·39	26·61	28·83	[illegible]
17·18	19·23	21·48	23·63	25·78	27·92	[illegible]

When the height of the ribs above the plain parts is [illegible]
1 5/16 inch, the depth of the grooves not greater than [illegible]
length not greater than 9 inches between the centres [illegible]
the plain parts at the ends not longer than 6 inches.

FURNACES WITH RIBBED PROJECTIONS, GROOVED INSIDE.

Steel Plates from $\frac{15}{32}$ inch to $\frac{5}{8}$ inch thick.
Pressures and Diameters.*

Pressure per square inch.	Thicknesses and Diameters.					
	15/32 in.	½ in.	17/32 in.	9/16 in.	19/32 in.	⅝ i
	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diameter in inches.	Diame in inch
lbs. 5	...	...	...	...	...	...
10	...	...	...	...	...	...
15	...	...	...	...	...	...
20	...	...	...	...	...	...
25	...	...	...	...	...	...
30	...	...	...	...	...	...
35	...	...	...	...	...	...
40	...	...	...	...	...	...
45	...	...	...	...	...	...
50	...	...	...	...	...	...
55	...	...	...	...	...	...
60	...	...	...	...	...	...
65	...	...	...	...	...	...
70	...	...	...	...	...	...
75	68·75	...	...	...	...	...
80	64·45	68·75	...	...	...	...
85	60·66	64·70	68·75	...	...	...
90	57·29	61·11	64·93	68·75	...	...
95	54·27	57·89	61·51	65·13	68·75	...
100	51·56	55	58·43	61·87	65·31	68·7
105	49·10	52·38	55·65	58·92	62·2	65·4
110	46·87	50	53·12	56·25	59·37	62·5
115	44·83	47·82	50·81	53·80	56·79	59·7
120	42·96	45·83	48·69	51·56	54·42	57·2
125	41·25	44	46·75	49·5	52·25	55
130	39·66	42·30	44·95	47·59	50·24	52·8
135	38·19	40·74	43·28	45·83	48·37	50·9
140	36·83	39·28	41·74	44·19	46·65	49·1
145	35·56	37·93	40·30	42·67	45·04	47·4
150	34·37	36·66	38·95	41·25	43·54	45·8
155	33·26	35·48	37·70	39·91	42·13	44·3
160	32·22	34·37	36·52	38·67	40·82	42·9

* When the height of the ribs above the plain parts is not l than 1⁹⁄₁₆ inch, the depth of the grooves not greater than ¾ in *the length* not greater than 9 inches between the centres of the ri *and the* plain parts at the ends not longer than 6 inches.

SPIRAL CORRUGATED FURNACES.

Steel Plates.

furnaces are known as the Farnley corrugated flue, or as Patent flue. It is the latest description of flue in the market, great number has yet been made.

iean outside diameter is the outside diameter of outer corruga- *nus* the depth of one corrugation, or the inside diameter of the rrugations *plus* twice the thickness of the tube *plus* the depth orrugation. When *about* 40 inches diameter, the pitch of the ions is *about* 6 feet, and it increases and decreases in about the io as the diameter increases and decreases, the distance between of corrugations being 6 inches, and the depth not less than ı from the top outside to the bottom outside; and when the rts at the ends do not exceed 4 inches, if made of the best tes not less than ⅝ inch thick, the working pressure may be ie same as for ribbed and grooved furnaces (Purvis's Patent), oe, say, *about* one per cent. greater. See Tables Nos. 178 and

AREAS OF CIRCLES.

The following Tables, Nos. 180 to 184, contain areas of circles whose diameters commence at ·01 and increase by one-hundredth part up to 9·99; they are applicable for larger diameters if attention be paid to the position of the decimal point.

For every figure the decimal point is shifted to the right in the diameter, the decimal point should be shifted *two* to the right in the area.

For example, if it be wished to find the area of 99, the area of 9·9 is found from the tables to be 76·9769, and the area of 99 is therefore 7697·69, and as the area of 9·99 from the tables is 78·3828, the area of 999 is 783828; the decimal point in the diameter in the latter case having been shifted two to the right, the decimal point in the area is consequently shifted double that number, or four places, also to the right.

By the foregoing method the tables can be made applicable up to to 999 diameter, or 100 times greater than given in the tables.

AREAS OF CIRCLES, ADVANCING BY HUNDREDTHS.

TABLE NO. 180.

Diam.	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09	Diam.
·0	·0	·000078	·000314	·000706	·001256	·001963	·002827	·003848	·005026	·006361	·0
·1	·007854	·009503	·011310	·013273	·015394	·017671	·020106	·022698	·025447	·028353	·1
·2	·031416	·034636	·038013	·041548	·045239	·049087	·053093	·057256	·061575	·066052	·2
·3	·070686	·075477	·080425	·085530	·090792	·096211	·10179	·10752	·11341	·11946	·3
·4	·12566	·13203	·13854	·14522	·15205	·15904	·16619	·17349	·18096	·18857	·4
·5	·19635	·20428	·21237	·22062	·22902	·23758	·24630	·25518	·26421	·27340	·5
·6	·28274	·29225	·30191	·31172	·32170	·33183	·34212	·35257	·36317	·37393	·6
·7	·38485	·39592	·40715	·41854	·43008	·44179	·45365	·46566	·47784	·49017	·7
·8	·50265	·51530	·52810	·54106	·55418	·56745	·58088	·59447	·60821	·62211	·8
·9	·63617	·65039	·66476	·67929	·69398	·70882	·72382	·73898	·75430	·76977	·9
1·0	·78540	·80118	·81713	·83323	·84949	·86590	·88247	·89920	·91609	·93313	1·0
1·1	·95033	·96769	·98520	1·0029	1·0207	1·0387	1·0568	1·0751	1·0936	1·1122	1·1
1·2	1·1310	1·1499	1·1690	1·1882	1·2076	1·2272	1·2469	1·2668	1·2868	1·3070	1·2
1·3	1·3273	1·3478	1·3685	1·3893	1·4103	1·4314	1·4527	1·4741	1·4957	1·5175	1·3
1·4	1·5394	1·5615	1·5837	1·6061	1·6286	1·6513	1·6742	1·6972	1·7203	1·7437	1·4
1·5	1·7671	1·7908	1·8146	1·8385	1·8627	1·8869	1·9113	1·9359	1·9607	1·9856	1·5
1·6	2·0106	2·0358	2·0612	2·0867	2·1124	2·1382	2·1642	2·1904	2·2167	2·2432	1·6
1·7	2·2698	2·2966	2·3235	2·3506	2·3779	2·4053	2·4328	2·4606	2·4885	2·5165	1·7
1·8	2·5447	2·5730	2·6016	2·6302	2·6590	2·6880	2·7172	2·7465	2·7759	2·8055	1·8
1·9	2·8353	2·8652	2·8953	2·9255	2·9559	2·9865	3·0172	3·0481	3·0791	3·1103	1·9
2·0	3·1416	3·1731	3·2047	3·2365	3·2685	3·3006	3·3329	3·3654	3·3979	3·4307	2·0

AREAS OF CIRCLES, ADVANCING BY HUNDREDTHS. TABLE No. 181.

Diam.	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09	Diam.
2·1	3·4636	3·4967	3·5299	3·5633	3·5968	3·6305	3·6644	3·6984	3·7325	3·7668	2·1
2·2	3·8013	3·8360	3·8708	3·9057	3·9408	3·9761	4·0115	4·0471	4·0828	4·1187	2·2
2·3	4·1548	4·1910	4·2273	4·2638	4·3005	4·3374	4·3744	4·4115	4·4488	4·4863	2·3
2·4	4·5239	4·5617	4·5996	4·6877	4·6759	4·7144	4·7529	4·7916	4·8305	4·8695	2·4
2·5	4·9087	4·9481	4·9876	5·0273	5·0671	5·1071	5·1472	5·1875	5·2279	5·2685	2·5
2·6	5·3093	5·3502	5·3913	5·4325	5·4739	5·5155	5·5572	5·5990	5·6410	5·6832	2·6
2·7	5·7256	5·7680	5·8107	5·8535	5·8965	5·9396	5·9828	6·0263	6·0699	6·1136	2·7
2·8	6·1575	6·2016	6·2458	6·2902	6·3347	6·3794	6·4242	6·4692	6·5144	6·5597	2·8
2·9	6·6052	6·6508	6·6966	6·7426	6·7887	6·8349	6·8813	6·9279	6·9747	7·0215	2·9
3·0	7·0686	7·1158	7·1631	7·2107	7·2583	7·3062	7·3542	7·4023	7·4506	7·4991	3·0
3·1	7·5477	7·5964	7·6454	7·6945	7·7437	7·7931	7·8427	7·8924	7·9423	7·9923	3·1
3·2	8·0425	8·0928	8·1433	8·1940	8·2448	8·2958	8·3469	8·3982	8·4496	8·5012	3·2
3·3	8·5530	8·6049	8·6570	8·7092	8·7616	8·8141	8·8668	8·9197	8·9727	9·0259	3·3
3·4	9·0792	9·1327	9·1863	9·2401	9·2941	9·3482	9·4025	9·4569	9·5115	9·5662	3·4
3·5	9·6211	9·6762	9·7314	9·7868	9·8423	9·8980	9·9538	10·0098	10·0660	10·1223	3·5
3·6	10·1788	10·2354	10·2922	10·3491	10·4062	10·4635	10·5209	10·5784	10·6362	10·6941	3·6
3·7	10·7521	10·8103	10·8687	10·9272	10·9858	11·0447	11·1036	11·1628	11·2221	11·2815	3·7
3·8	11·3411	11·4009	11·4608	11·5209	11·5812	11·6416	11·7021	11·7628	11·8237	11·8847	3·8
3·9	11·9459	12·0072	12·0687	12·1304	12·1922	12·2542	12·3163	12·3786	12·4410	12·5036	3·9

TABLE No. 182.

AREAS OF CIRCLES, ADVANCING BY HUNDREDTHS.

Diam.	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09	Diam.
4·2	13·8544	13·9205	13·9867	14·0531	14·1196	14·1863	14·2531	14·3201	14·3872	14·4545	4·2
4·3	14·5220	14·5896	14·6574	14·7254	14·7934	14·8617	14·9301	14·9987	15·0674	15·1363	4·3
4·4	15·2053	15·2745	15·3439	15·4134	15·4830	15·5528	15·6228	15·6930	15·7633	15·8337	4·4
4·5	15·9043	15·9751	16·0460	16·1171	16·1883	16·2597	16·3313	16·4030	16·4748	16·5468	4·5
4·6	16·6190	16·6914	16·7639	16·8365	16·9093	16·9823	17·0554	17·1287	17·2021	17·2757	4·6
4·7	17·3494	17·4234	17·4974	17·5716	17·6460	17·7205	17·7952	17·8701	17·9451	18·0203	4·7
4·8	18·0956	18·1711	18·2467	18·3225	18·3984	18·4745	18·5508	18·6272	18·7038	18·7805	4·8
4·9	18·8574	18·9345	19·0117	19·0890	19·1665	19·2442	19·3221	19·4000	19·4782	19·5565	4·9
5·0	19·6350	19·7136	19·7923	19·8713	19·9504	20·0296	20·1090	20·1886	20·2683	20·3482	5·0
5·1	20·4282	20·5084	20·5887	20·6692	20·7499	20·8307	20·9117	20·9928	21·0741	21·1556	5·1
5·2	21·2372	21·3189	21·4008	21·4829	21·5651	21·6475	21·7301	21·8128	21·8956	21·9787	5·2
5·3	22·0618	22·1452	22·2287	22·3123	22·3961	22·4801	22·5642	22·6484	22·7329	22·8175	5·3
5·4	22·9022	22·9871	23·0722	23·1574	23·2428	23·3283	23·4140	23·4998	23·5858	23·6720	5·4
5·5	23·7583	23·8448	23·9314	24·0182	24·1051	24·1922	24·2795	24·3669	24·4545	24·5422	5·5
5·6	24·6301	24·7181	24·8063	24·8947	24·9832	25·0719	25·1607	25·2497	25·3388	25·4281	5·6
5·7	25·5176	25·6072	25·6970	25·7869	25·8770	25·9672	26·0576	26·1482	26·2389	26·3298	5·7
5·8	26·4208	26·5120	26·6033	26·6948	26·7865	26·8783	26·9703	27·0624	27·1547	27·2471	5·8
5·9	27·3397	27·4325	27·5254	27·6184	27·7117	27·8051	27·8986	27·9923	28·0862	28·1802	5·9
6·0	28·2743	28·3687	28·4631	28·5578	28·6526	28·7475	28·8426	28·9379	29·0333	29·1289	6·0

TABLE No. 183.

AREAS OF CIRCLES, ADVANCING BY HUNDREDTHS.

Diam.	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09	Diam.
6·1	29·2247	29·3206	29·4166	29·5128	29·6092	29·7057	29·8024	29·8992	29·9962	30·0934	6·1
6·2	30·1907	30·2882	30·3858	30·4836	30·5815	30·6796	30·7779	30·8763	30·9748	31·0736	6·2
6·3	31·1725	31·2715	31·3707	31·4700	31·5696	31·6692	31·7690	31·8690	31·9692	32·0695	6·3
6·4	32·1699	32·2705	32·3713	32·4722	32·5733	32·6745	32·7759	32·8775	32·9792	33·0811	6·4
6·5	33·1831	33·2853	33·3876	33·4901	33·5927	33·6955	33·7985	33·9016	34·0049	34·1084	6·5
6·6	34·2119	34·3157	34·4196	34·5237	34·6279	34·7323	34·8368	34·9415	35·0464	35·1514	6·6
6·7	35·2565	35·3618	35·4673	35·5730	35·6788	35·7847	35·8908	35·9971	36·1035	36·2101	6·7
6·8	36·3168	36·4237	36·5308	36·6380	36·7453	36·8528	36·9605	37·0684	37·1764	37·2845	6·8
6·9	37·3928	37·5013	37·6099	37·7187	37·8276	37·9367	38·0459	38·1554	38·2649	38·3746	6·9
7·0	38·4845	38·5945	38·7047	38·8151	38·9256	39·0363	39·1471	39·2581	39·3692	39·4805	7·0
7·1	39·5919	39·7035	39·8153	39·9272	40·0393	40·1515	40·2639	40·3765	40·4892	40·6020	7·1
7·2	40·7150	40·8282	40·9416	41·0550	41·1687	41·2825	41·3965	41·5106	41·6248	41·7393	7·2
7·3	41·8539	41·9686	42·0835	42·1986	42·3138	42·4292	42·5447	42·6604	42·7762	42·8922	7·3
7·4	43·0084	43·1247	43·2412	43·3578	43·4746	43·5916	43·7087	43·8259	43·9433	44·0609	7·4
7·5	44·1786	44·2965	44·4146	44·5328	44·6511	44·7697	44·8883	45·0072	45·1262	45·2453	7·5
7·6	45·3646	45·4841	45·6037	45·7234	45·8434	45·9635	46·0837	46·2041	46·3247	46·4454	7·6
7·7	46·5663	46·6873	46·8085	46·9298	47·0513	47·1730	47·2948	47·4168	47·5389	47·6612	7·7

AREAS OF CIRCLES, ADVANCING BY HUNDREDTHS.

Diam.	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09	Diam.
8·0	50·2655	50·3912	50·5171	50·6432	50·7694	50·8958	51·0223	51·1490	51·2758	51·4028	8·0
8·1	51·5300	51·6573	51·7848	51·9124	52·0402	52·1681	52·2962	52·4245	52·5529	52·6814	8·1
8·2	52·8102	52·9391	53·0681	53·1973	53·3267	53·4562	53·5858	53·7157	53·8456	53·9758	8·2
8·3	54·1061	54·2365	54·3671	54·4979	54·6288	54·7599	54·8912	55·0226	55·1541	55·2858	8·3
8·4	55·4177	55·5497	55·6819	55·8142	55·9467	56·0794	56·2122	56·3452	56·4783	56·6116	8·4
8·5	56·7450	56·8786	57·0124	57·1463	57·2803	57·4146	57·5490	57·6835	57·8182	57·9530	8·5
8·6	58·0881	58·2232	58·3585	58·4940	58·6297	58·7655	58·9014	59·0375	59·1738	59·3102	8·6
8·7	59·4468	59·5835	59·7204	59·8575	59·9947	60·1320	60·2696	60·4073	60·5451	60·6831	8·7
8·8	60·8212	60·9595	61·0980	61·2366	61·3754	61·5144	61·6534	61·7927	61·9321	62·0717	8·8
8·9	62·2114	62·3513	62·4913	62·6315	62·7719	62·9124	63·0530	63·1938	63·3348	63·4760	8·9
9·0	63·6173	63·7587	63·9003	64·0421	64·1840	64·3261	64·4683	64·6107	64·7533	64·8960	9·0
9·1	65·0388	65·1818	65·3250	65·4684	65·6119	65·7555	65·8993	66·0433	66·1874	66·3317	9·1
9·2	66·4761	66·6207	66·7654	66·9104	67·0554	67·2006	67·3460	67·4915	67·6372	67·7831	9·2
9·3	67·9291	68·0753	68·2216	68·3680	68·5147	68·6615	68·8084	68·9555	69·1028	69·2502	9·3
9·4	69·3978	69·5455	69·6934	69·8415	69·9897	70·1380	70·2865	70·4352	70·5841	70·7330	9·4
9·5	70·8822	71·0315	71·1810	71·3306	71·4803	71·6303	71·7804	71·9306	72·0810	72·2316	9·5
9·6	72·3823	72·5332	72·6842	72·8354	72·9867	73·1382	73·2899	73·4417	73·5937	73·7458	9·6
9·7	73·8981	74·0506	74·2032	74·3559	74·5088	74·6619	74·8151	74·9685	75·1221	75·2758	9·7
9·8	75·4296	75·5837	75·7378	75·8922	76·0467	76·2013	76·3561	76·5111	76·6662	76·8214	9·8
9·9	76·9769	77·1325	77·2882	77·4441	77·6002	77·7564	77·9128	78·0693	78·2260	78·3828	9·9

AREAS OF CIRCLES.

The following Tables, Nos. 185 to 191, contain areas of circles for diameters, increasing by fractional parts of one thirty-second to 21, by one sixteenth from 21 to 49, and by one eighth from 49 to 104⅞ diameter.

AREAS OF CIRCLES.

Advancing by Thirty-Seconds.

Diam.	0	1	2	3	4	5	6	Diam.
		·78540	3·1416	7·0686	12·566	19·635	28·274	
1/32	·000767	·83525	3·2405	7·2166	12·763	19·881	28·570	1/32
1/16	·003068	·88664	3·3410	7·3662	12·962	20·129	28·866	1/16
3/32	·006903	·93956	3·4430	7·5173	13·162	20·378	29·165	3/32
1/8	·012272	·99402	3·5466	7·6699	13·364	20·629	29·465	1/8
5/32	·019175	1·0500	3·6516	7·8241	13·567	20·881	29·766	5/32
3/16	·027612	1·1075	3·7583	7.9798	13·772	21·135	30·069	3/16
7/32	·037583	1·1666	3·8664	8·1370	13·978	21·391	30·374	7/32
1/4	·049087	1·2272	3·9761	8·2958	14·186	21·648	30·680	1/4
9/32	·062126	1·2893	4·0873	8·4561	14·396	21·906	30·987	9/32
5/16	·076699	1·3530	4·2000	8·6179	14·607	22·166	31·296	5/16
11/32	·092806	1·4182	4·3143	8·7813	14·819	22·428	31·607	11/32
3/8	·11045	1·4849	4·4301	8·9462	15·033	22·691	31·919	3/8
13/32	·12962	1·5532	4·5475	9·1126	15·249	22·955	32·233	13/32
7/16	·15033	1·6230	4·6664	9·2806	15·466	23·221	32·548	7/16
15/32	·17257	1·6943	4·7868	9·4501	15·684	23·489	32·865	15/32
1/2	·19635	1·7671	4·9087	9·6211	15·904	23·758	33·183	1/2
17/32	·22166	1·8415	5·0322	9·7937	16·126	24·029	33·503	17/32
9/16	·24850	1·9175	5·1572	9·9678	16·349	24·301	33·824	9/16
19/32	·27688	1·9949	5·2838	10·143	16·574	24·575	34·147	19/32
5/8	·30680	2·0739	5·4119	10·321	16·800	24·850	34·472	5/8
21/32	·33824	2·1545	5·5415	10·499	17·028	25·127	34·798	21/32
11/16	·37122	2·2365	5·6727	10·680	17·257	25·406	35·125	11/16
23/32	·40574	2·3201	5·8054	10·861	17·488	25·686	35·454	23/32
3/4	·44179	2·4053	5·9396	11·045	17·721	25·967	35·785	3/4
25/32	·47937	2·4920	6·0753	11·230	17·954	26·250	36·117	25/32
13/16	·51849	2·5802	6·2126	11·416	18·190	26·535	36·450	13/16
27/32	·55914	2·6699	6·3514	11·604	18·427	26·821	36·786	27/32
7/8	·60132	2·7612	6·4918	11·793	18·665	27·109	37·122	7/8
29/32	·64504	2·8540	6·6337	11·984	18·906	27·398	37·461	29/32
15/16	·69029	2·9483	6·7771	12·177	19·147	27·688	37·800	15/16
31/32	·73708	3·0442	6·9221	12·371	19·390	27·981	38·142	31/32

AREAS OF CIRCLES.

Advancing by Thirty-Seconds.

Diam.	7	8	9	10	11	12	13	Diam.
	38·485	50·265	63·617	78·540	95·033	113·10	132·73	
1/32	38·829	50·659	64·060	79·031	95·574	113·69	133·37	1/32
1/16	39·175	51·054	64·504	79·525	96·116	114·28	134·01	1/16
3/32	39·522	51·450	64·950	80·019	96·660	114·87	134·65	3/32
1/8	39·871	51·849	65·397	80·516	97·205	115·47	135·30	1/8
5/32	40·222	52·248	65·845	81·013	97·752	116·06	135·94	5/32
3/16	40·574	52·649	66·296	81·513	98·301	116·66	136·59	3/16
7/32	40·927	53·052	66·747	82·014	98·850	117·26	137·24	7/32
1/4	41·282	53·456	67·201	82·516	99·402	117·86	137·89	1/4
9/32	41·639	53·862	67·655	83·020	99·955	118·46	138·54	9/32
5/16	41·997	54·269	68·112	83·525	100·51	119·06	139·19	5/16
11/32	42·357	54·678	68·570	84·032	101·07	119·67	139·84	11/32
3/8	42·718	55·088	69·029	84·541	101·62	120·28	140·50	3/8
13/32	43·081	55·500	69·490	85·051	102·18	120·88	141·16	13/32
7/16	43·445	55·914	69·953	85·562	102·74	121·49	141·82	7/16
15/32	43·811	56·329	70·417	86·076	103·31	122·11	142·48	15/32
1/2	44·179	56·745	70·882	86·590	103·87	122·72	143·14	1/2
17/32	44·548	57·163	71·349	87·106	104·43	123·33	143·80	17/32
9/16	44·918	57·583	71·818	87·624	105·00	123·95	144·47	9/16
19/32	45·290	58·004	72·288	88·143	105·57	124·57	145·13	19/32
5/8	45·664	58·426	72·760	88·664	106·14	125·19	145·80	5/8
21/32	46·039	58·850	73·233	89·186	106·71	125·81	146·47	21/32
11/16	46·415	59·276	73·708	89·710	107·28	126·43	147·14	11/16
23/32	46·793	59·703	74·184	90·236	107·86	127·05	147·82	23/32
3/4	47·173	60·132	74·662	90·763	108·43	127·68	148·49	3/4
25/32	47·554	60·562	75·141	91·291	109·01	128·30	149·17	25/32
13/16	47·937	60·994	75·622	91·821	109·59	128·93	149·84	13/16
27/32	48·321	61·427	76·105	92·353	110·17	129·56	150·52	27/32
7/8	48·707	61·862	76·589	92·886	110·75	130·19	151·20	7/8
29/32	49·094	62·299	77·074	93·420	111·34	130·82	151·88	29/32
15/16	49·483	62·737	77·561	93·956	111·92	131·46	152·57	15/16
31/32	49·874	63·176	78·050	94·494	112·51	132·09	153·25	31/32

AREAS OF CIRCLES.

Advancing by Thirty-Seconds.

Diam.	14	15	16	17	18	19	20	Diam.
	153·94	176·71	201·06	226·98	254·47	283·53	314·16	
1/32	154·63	177·45	201·85	227·82	255·35	284·46	315·14	1/32
1/16	155·32	178·19	202·64	228·65	256·24	285·40	316·13	1/16
3/32	156·01	178·93	203·43	229·49	257·13	286·33	317·11	3/32
1/8	156·70	179·67	204·22	230·33	258·02	287·27	318·10	1/8
5/32	157·39	180·42	205·01	231·17	258·91	288·21	319·09	5/32
3/16	158·09	181·16	205·80	232·01	259·80	289·15	320·08	3/16
7/32	158·79	181·91	206·60	232·86	260·69	290·09	321·07	7/32
1/4	159·48	182·65	207·39	233·71	261·59	291·04	322·06	1/4
9/32	160·19	183·40	208·19	234·55	262·48	291·98	323·06	9/32
5/16	160·89	184·15	208·99	235·40	263·38	292·93	324·05	5/16
11/32	161·59	184·91	209·79	236·25	264·28	293·88	325·05	11/32
3/8	162·30	185·66	210·60	237·10	265·18	294·83	326·05	3/8
13/32	163·00	186·42	211·40	237·96	266·09	295·78	327·05	13/32
7/16	163·71	187·17	212·21	238·81	266·99	296·74	328·05	7/16
15/32	164·42	187·93	213·02	239·67	267·90	297·69	329·06	15/32
1/2	165·13	188·69	213·82	240·53	268·80	298·65	330·06	1/2
17/32	165·84	189·45	214·64	241·39	269·71	299·61	331·07	17/32
9/16	166·56	190·22	215·45	242·25	270·62	300·57	332·08	9/16
19/32	167·27	190·98	216·26	243·11	271·53	301·53	333·09	19/32
5/8	167·99	191·75	217·08	243·98	272·45	302·49	334·10	5/8
21/32	168·71	192·52	217·89	244·84	273·36	303·45	335·11	21/32
11/16	169·43	193·28	218·71	245·71	274·28	304·42	336·13	11/16
23/32	170·15	194·06	219·53	246·58	275·20	305·39	337·15	23/32
3/4	170·87	194·83	220·35	247·45	276·12	306·35	338·16	3/4
25/32	171·60	195·60	221·18	248·32	277·04	307·32	339·18	25/32
13/16	172·32	196·38	222·00	249·20	277·96	308·30	340·20	13/16
27/32	173·05	197·15	222·83	250·07	278·88	309·27	341·23	27/32
7/8	173·78	197·93	223·65	250·95	279·81	310·24	342·25	7/8
29/32	174·51	198·71	224·48	251·83	280·74	311·22	343·28	29/32
15/16	175·25	199·49	225·31	252·70	281·67	312·20	344·30	15/16
31/32	175·98	200·28	226·15	253·59	282·60	313·18	345·33	31/32

AREAS OF CIRCLES.

Advancing by Sixteenths.

Diam.	21	22	23	24	25	26	27	Diam.
	346·36	380·13	415·48	452·39	490·87	530·93	572·56	
1/16	348·43	382·30	417·74	454·75	493·33	533·48	575·21	1/16
1/8	350·50	384·46	420·00	457·11	495·79	536·05	577·87	1/8
3/16	352·57	386·64	422·28	459·49	498·26	538·61	580·54	3/16
1/4	354·66	388·82	424·56	461·86	500·74	541·19	583·21	1/4
5/16	356·75	391·01	426·84	464·25	503·22	543·77	585·89	5/16
3/8	358·84	393·20	429·13	466·64	505·71	546·35	588·57	3/8
7/16	360·94	395·40	431·43	469·03	508·20	548·95	591·26	7/16
1/2	363·05	397·61	433·74	471·44	510·71	551·55	593·96	1/2
9/16	365·16	399·82	436·05	473·84	513·21	554·15	596·66	9/16
5/8	367·28	402·04	438·36	476·26	515·72	556·76	599·37	5/8
11/16	369·41	404·26	440·69	478·68	518·24	559·38	602·08	11/16
3/4	371·54	406·49	443·01	481·11	520·77	562·00	604·81	3/4
13/16	373·68	408·73	445·35	483·54	523·30	564·63	607·53	13/16
7/8	375·83	410·97	447·69	485·98	525·84	567·27	610·27	7/8
15/16	377·98	413·22	450·04	488·42	528·38	569·91	613·01	15/16

Diam.	28	29	30	31	32	33	34	Diam.
	615·75	660·52	706·86	754·77	804·25	855·30	907·92	
1/16	618·50	663·37	709·81	757·81	807·39	858·54	911·26	1/16
1/8	621·26	666·23	712·76	760·87	810·54	861·79	914·61	1/8
3/16	624·03	669·09	715·72	763·93	813·70	865·05	917·96	3/16
1/4	626·80	671·96	718·69	766·99	816·86	868·31	921·32	1/4
5/16	629·57	674·83	721·66	770·06	820·03	871·57	924·69	5/16
3/8	632·36	677·71	724·64	773·14	823·21	874·85	928·06	3/8
7/16	635·14	680·60	727·63	776·22	826·39	878·13	931·44	7/16
1/2	637·94	683·49	730·62	779·31	829·58	881·41	934·82	1/2
9/16	640·74	686·39	733·61	782·41	832·77	884·71	938·21	9/16
5/8	643·55	689·30	736·62	785·51	835·97	888·00	941·61	5/8
11/16	646·36	692·21	739·63	788·62	839·18	891·31	945·01	11/16
3/4	649·18	695·13	742·64	791·73	842·39	894·62	948·42	3/4
13/16	652·01	698·05	745·67	794·85	845·61	897·93	951·83	13/16
7/8	654·84	700·98	748·69	797·98	848·83	901·26	955·25	7/8
15/16	657·68	703·92	751·73	801·11	852·06	904·59	958·68	15/16

AREAS OF CIRCLES.

Advancing by Sixteenths.

Diam.	35	36	37	38	39	40	41	Diam.
	962·11	1017·9	1075·2	1134·1	1194·6	1256·6	1320·3	
1/16	965·55	1021·4	1078·8	1137·8	1198·4	1260·6	1324·3	1/16
1/8	969·00	1025·0	1082·5	1141·6	1202·3	1264·5	1328·3	1/8
3/16	972·45	1028·5	1086·1	1145·3	1206·1	1268·4	1332·4	3/16
1/4	975·91	1032·1	1089·8	1149·1	1210·0	1272·4	1336·4	1/4
5/16	979·37	1035·6	1093·4	1152·8	1213·8	1276·3	1340·5	5/16
3/8	982·84	1039·2	1097·1	1156·6	1217·7	1280·3	1344·5	3/8
7/16	986·32	1042·8	1100·8	1160·4	1221·5	1284·3	1348·6	7/16
1/2	989·80	1046·3	1104·5	1164·2	1225·4	1288·2	1352·7	1/2
9/16	993·29	1049·9	1108·2	1167·9	1229·3	1292·2	1356·7	9/16
5/8	996·78	1053·5	1111·8	1171·7	1233·2	1296·2	1360·8	5/8
11/16	1000·3	1057·1	1115·5	1175·5	1237·1	1300·2	1364·9	11/16
3/4	1003·8	1060·7	1119·2	1179·3	1241·0	1304·2	1369·0	3/4
13/16	1007·3	1064·3	1123·0	1183·1	1244·9	1308·2	1373·1	13/16
7/8	1010·8	1068·0	1126·7	1186·9	1248·8	1312·2	1377·2	7/8
15/16	1014·3	1071·6	1130·4	1190·8	1252·7	1316·2	1381·3	15/16

Diam.	42	43	44	45	46	47	48	Diam.
	1385·4	1452·2	1520·5	1590·4	1661·9	1734·9	1809·6	
1/16	1389·6	1456·4	1524·9	1594·9	1666·4	1739·6	1814·3	1/16
1/8	1393·7	1460·7	1529·2	1599·3	1670·9	1744·2	1819·0	1/8
3/16	1397·8	1464·9	1533·5	1603·7	1675·5	1748·8	1823·7	3/16
1/4	1402·0	1469·1	1537·9	1608·2	1680·0	1753·5	1828·5	1/4
5/16	1406·1	1473·4	1542·2	1612·6	1684·6	1758·1	1833·2	5/16
3/8	1410·3	1477·6	1546·6	1617·0	1689·1	1762·7	1837·9	3/8
7/16	1414·5	1481·9	1550·9	1621·5	1693·7	1767·4	1842·7	7/16
1/2	1418·6	1486·2	1555·3	1626·0	1698·2	1772·1	1847·5	1/2
9/16	1422·8	1490·4	1559·7	1630·4	1702·8	1776·7	1852·2	9/16
5/8	1427·0	1494·7	1564·0	1634·9	1707·4	1781·4	1857·0	5/8
11/16	1431·2	1499·0	1568·4	1639·4	1712·0	1786·1	1861·8	11/16
3/4	1435·4	1503·3	1572·8	1643·9	1716·5	1790·8	1866·5	3/4
13/16	1439·6	1507·6	1577·2	1648·4	1721·1	1795·4	1871·3	13/16
7/8	1443·8	1511·9	1581·6	1652·9	1725·7	1800·1	1876·1	7/8
15/16	1448·0	1516·2	1586·0	1657·4	1730·3	1804·8	1880·9	15/16

Advancing by Eighths.

Diam.	49	50	51	52	53	54	55	Diam.
	1885·7	1963·5	2042·8	2123·7	2206·2	2290·2	2375·8	
1/8	1895·4	1973·3	2052·8	2133·9	2216·6	2300·8	2386·6	1/8
1/4	1905·0	1983·2	2062·9	2144·2	2227·0	2311·5	2397·5	1/4
3/8	1914·7	1993·1	2073·0	2154·5	2237·5	2322·1	2408·3	3/8
1/2	1924·4	2003·0	2083·1	2164·8	2248·0	2332·8	2419·2	1/2
5/8	1934·2	2012·9	2093·2	2175·1	2258·5	2343·5	2430·1	5/8
3/4	1943·9	2022·8	2103·3	2185·4	2269·1	2354·3	2441·1	3/4
7/8	1953·7	2032·8	2113·5	2195·8	2279·6	2365·0	2452·0	7/8
Diam.	56	57	58	59	60	61	62	Diam.
	2463·0	2551·8	2642·1	2734·0	2827·4	2922·5	3019·1	
1/8	2474·0	2563·0	2653·5	2745·6	2839·2	2934·5	3031·3	1/8
1/4	2485·0	2574·2	2664·9	2757·2	2851·0	2946·5	3043·5	1/4
3/8	2496·1	2585·4	2676·4	2768·8	2862·9	2958·5	3055·7	3/8
1/2	2507·2	2596·7	2687·8	2780·5	2874·8	2970·6	3068·0	1/2
5/8	2518·3	2608·0	2699·3	2792·2	2886·6	2982·7	3080·2	5/8
3/4	2529·4	2619·4	2710·9	2803·9	2898·6	2994·8	3092·6	3/4
7/8	2540·6	2630·7	2722·4	2815·7	2910·5	3006·9	3104·9	7/8
Diam.	63	64	65	66	67	68	69	Diam.
	3117·2	3217·0	3318·3	3421·2	3525·7	3631·7	3739·3	
1/8	3129·6	3229·6	3331·1	3434·2	3538·8	3645·0	3752·8	1/8
1/4	3142·0	3242·2	3343·9	3447·2	3552·0	3658·4	3766·4	1/4
3/8	3154·5	3254·8	3356·7	3460·2	3565·2	3671·8	3780·0	3/8
1/2	3166·9	3267·5	3369·6	3473·2	3578·5	3685·3	3793·7	1/2
5/8	3179·4	3280·1	3382·4	3486·3	3591·7	3698·7	3807·3	5/8
3/4	3191·9	3292·8	3395·3	3499·4	3605·0	3712·2	3821·0	3/4
7/8	3204·4	3305·6	3408·2	3512·5	3618·3	3725·7	3834·7	7/8
Diam.	70	71	72	73	74	75	76	Diam.
	3848·5	3959·2	4071·5	4185·4	4300·8	4417·9	4536·5	
1/8	3862·2	3973·1	4085·7	4199·7	4315·4	4432·6	4551·4	1/8
1/4	3876·0	3987·1	4099·8	4214·1	4329·9	4447·4	4566·4	1/4
3/8	3889·8	4001·1	4114·0	4228·5	4344·5	4462·2	4581·3	3/8
1/2	3903·6	4015·2	4128·2	4242·9	4359·2	4477·0	4596·3	1/2
5/8	3917·5	4029·2	4142·5	4257·4	4373·8	4491·8	4611·4	5/8
3/4	3931·4	4043·3	4156·8	4271·8	4388·5	4506·7	4626·4	3/4
7/8	3945·3	4057·4	4171·1	4286·3	4403·2	4521·5	4641·5	7/8

AREAS OF CIRCLES.

Advancing by Eighths.

Diam.	77	78	79	80	81	[illegible]	[illegible]
	4656·6	4778·4	4901·7	5026·5	5153·0	[illegible]	[illegible]
⅛	4671·8	4793·7	4917·2	5042·3	5168·8	[illegible]	[illegible]
¼	4686·9	4809·0	4932·7	5058·0	5184·8	[illegible]	[illegible]
⅜	4702·1	4824·4	4948·3	5073·8	5200·7	[illegible]	[illegible]
½	4717·3	4839·8	4963·9	5089·6	5216·8	[illegible]	[illegible]
⅝	4732·5	4855·2	4979·5	5105·4	5232·8	[illegible]	[illegible]
¾	4747·8	4870·7	4995·2	5121·2	5248·9	[illegible]	[illegible]
⅞	4763·1	4886·2	5010·9	5137·1	5264·9	[illegible]	[illegible]

Diam.	84	85	86	87	88	89	[illegible]
	5541·8	5674·5	5808·8	5944·7	6082·1	6221·1	[illegible]
⅛	5558·3	5691·2	5825·7	5961·8	6099·4	6238·6	[illegible]
¼	5574·8	5707·9	5842·6	5978·9	6116·7	6256·1	[illegible]
⅜	5591·4	5724·7	5859·6	5996·0	6134·1	6273·7	[illegible]
½	5607·9	5741·5	5876·5	6013·2	6151·4	6291·2	[illegible]
⅝	5624·5	5758·3	5893·5	6030·4	6168·8	6308·8	[illegible]
¾	5641·2	5775·1	5910·6	6047·6	6186·2	6326·4	[illegible]
⅞	5657·8	5791·9	5927·6	6064·9	6203·7	6344·1	[illegible]

Diam.	91	92	93	94	95	96
	6503·9	6647·6	6792·9	6939·8	7088·2	7238·[illegible]
⅛	6521·8	6665·7	6811·2	6958·2	7106·9	725[illegible]
¼	6539·7	6683·8	6829·5	6976·7	7125·6	727[illegible]
⅜	6557·6	6701·9	6847·8	6995·3	7144·3	729[illegible]
½	6575·6	6720·1	6866·1	7013·8	7163·0	731[illegible]
⅝	6593·5	6738·2	6884·5	7032·4	7181·8	733[illegible]
¾	6611·5	6756·4	6902·9	7051·0	7200·6	73[illegible]
⅞	6629·6	6774·7	6921·3	7069·6	7219·4	73[illegible]

Diam.	98	99	100	101	102
	7543·0	[illegible]	[illegible]	8011·8	8171·3
⅛	7562·2	[illegible]	[illegible]	8031·7	8191·3
¼	7581·5	[illegible]	[illegible]	8051·6	8211·[illegible]
⅜	7600·[illegible]	[illegible]	[illegible]	8071·5	8231·[illegible]
½	7620·[illegible]	[illegible]	[illegible]	8091·4	8251[illegible]
⅝	7639·5	[illegible]	[illegible]	8111·3	827[illegible]
¾	7658·[illegible]	[illegible]	[illegible]	8131·3	82[illegible]
⅞	7678·[illegible]	[illegible]	[illegible]	8151·3	83[illegible]

CIRCUMFERENCES OF CIRCLES.

Advancing by Thirty-seconds.

Fractions.	0	1	2	3	4	5	6	7
	...	3·1416	6·2832	9·4248	12·566	15·708	18·850	21·991
1/32	·09817	3·2398	6·3814	9·5230	12·665	15·806	18·948	22·089
1/16	·19635	3·3379	6·4795	9·6211	12·763	15·904	19·046	22·187
3/32	·29452	3·4361	6·5777	9·7193	12·861	16·002	19·144	22·286
1/8	·39270	3·5343	6·6759	9·8175	12·959	16·101	19·242	22·384
5/32	·49087	3·6325	6·7741	9·9157	13·057	16·199	19·340	22·482
3/16	·58905	3·7306	6·8722	10·014	13·155	16·297	19·439	22·580
7/32	·68722	3·8288	6·9704	10·112	13·254	16·395	19·537	22·678
1/4	·78540	3·9270	7·0686	10·210	13·352	16·493	19·635	22·777
9/32	·88357	4·0252	7·1668	10·308	13·450	16·592	19·733	22·875
5/16	·98175	4·1233	7·2649	10·407	13·548	16·690	19·831	22·973
11/32	1·0799	4·2215	7·3631	10·505	13·646	16·788	19·929	23·071
3/8	1·1781	4·3197	7·4613	10·603	13·744	16·886	20·028	23·169
13/32	1·2763	4·4179	7·5595	10·701	13·843	16·984	20·126	23·267
7/16	1·3744	4·5160	7·6576	10·799	13·941	17·082	20·224	23·366
15/32	1·4726	4·6142	7·7558	10·897	14·039	17·181	20·322	23·464
1/2	1·5708	4·7124	7·8540	10·996	14·137	17·279	20·420	23·562
17/32	1·6690	4·8106	7·9522	11·094	14·235	17·377	20·519	23·660
9/16	1·7671	4·9087	8·0503	11·192	14·334	17·475	20·617	23·758
19/32	1·8653	5·0069	8·1485	11·290	14·432	17·573	20·715	23·856
5/8	1·9635	5·1051	8·2467	11·388	14·530	17·671	20·813	23·955
21/32	2·0617	5·2033	8·3449	11·486	14·628	17·770	20·911	24·053
11/16	2·1598	5·3014	8·4430	11·585	14·726	17·868	21·009	24·151
23/32	2·2580	5·3996	8·5412	11·683	14·824	17·966	21·108	24·249
3/4	2·3562	5·4978	8·6394	11·781	14·923	18·064	21·206	24·347
25/32	2·4544	5·5960	8·7376	11·879	15·021	18·162	21·304	24·446
13/16	2·5525	5·6941	8·8357	11·977	15·119	18·261	21·402	24·544
27/32	2·6507	5·7923	8·9339	12·075	15·217	18·359	21·500	24·642
7/8	2·7489	5·8905	9·0321	12·174	15·315	18·457	21·598	24·740
29/32	2·8471	5·9887	9·1303	12·272	15·413	18·555	21·697	24·838
15/16	2·9452	6·0868	9·2284	12·370	15·512	18·653	21·795	24·936
31/32	3·0434	6·1850	9·3266	12·468	15·610	18·751	21·893	25·035

When the circumference is required to be found to greater accuracy than given in above Table, multiply the diameter by 3·14159265359, but the circumferences as given in the Table are sufficiently accurate for general engineering purposes.

NUMBERS, VULGAR FRACTIONS, DECIMAL EQUIVALENTS, SQUARES, AND CUBES.

The following Tables, Nos. 193 to 199, contain decimal equivalents of fractions commencing at one sixty-fourth, and increasing by one sixty-fourth up to 2, and by one thirty-second from 2 to 6.

The squares and cubes of fractions and numbers are complete up to $3\frac{5}{16}$. Above $3\frac{5}{16}$, in Tables Nos. 197 to 199, the squares and cubes are given up to $29\frac{3}{4}$, but they are only given to three decimal places, which for practical purposes will *generally* be found to be sufficiently accurate. The numbers increase by one thirty-second up to 6, by sixteenths from 6 to 12, by eighths from 12 to 24, and by one quarter from 24 to $29\frac{3}{4}$.

The following notes may serve to facilitate the obtaining of the squares and cubes of numbers not included in the tables :—

> The square of any given number, multiplied by 4, equals the square of twice the given number.
>
> The square of any given number, multiplied by 9, equals the square of three times the given number.
>
> Or, for all cases, it follows that—

If N represents any given number and S the square of N, the square of any multiple of N may be found by multiplying S by the square of the multiple of N determined on; for example—

> If N equals a given number and S the square of N, and the square of 8 times N is required, then $S \times 64$ equals the square of 8N or $(8N)^2$.
>
> The cube of any given number, multiplied by 8, equals the cube of twice the given number.
>
> The cube of any given number, multiplied by 27, equals the cube of three times the given number.

Or, if N represents any given number and C the cube of whatever N may be, then, if the cube of any multiple of N be required, it can be found by multiplying C by the cube of the multiple of N determined on; for example—

> If N equals a given number, C the cube of N, and the cube of 10 times N is required, then $C \times 1000$ equals the cube of 10N or $(10N)^3$.

The tables may also be conveniently used for obtaining the square and cube roots of such numbers as are represented by the squares and cubes, the roots being complete up to 3·3125; above that they will be found near enough for ordinary purposes, as the squares and cubes are only a few decimal places short, which is generally of no great practical value.

The tables have a higher range than is necessary for the calculations connected with boilers and safety valves, so as to make them useful for other purposes.

There are several other tables which will reduce labour, and be found of varied use, such as the fourth power of numbers, Table No. 202; inches, and their decimal equivalents of a foot, Table No. 200; also decimal fractions from ·01 to ·99, and their equivalent values in *vulgar fractions, with the* sixty-fourths to which they are nearest *or than which they are greater* or less.

VULGAR FRACTIONS, DECIMAL EQUIVALENTS, SQUARES AND CUBES. TABLE No. 193.

Fractions.					= Equivalents.	Squares.	Cubes.
				1/64	·015625	·000244140625	·000003814697265625
			1/32	2/64	·03125	·0009765625	·000030517578125
				3/64	·046875	·002197265625	·000102996826171875
		1/16	2/32	4/64	·0625	·00390625	·000244140625
				5/64	·078125	·006103515625	·000476837158203125
			3/32	6/64	·09375	·0087890625	·000823974609375
				7/64	109375	·011962890625	·001308441162109375
	1/8	2/16	4/32	8/64	·125	·015625	·001953125
				9/64	·140625	·019775390625	·002780914306640625
			5/32	10/64	·15625	·0244140625	·003814697265625
				11/64	·171875	·029541015625	·005077362060546875
		3/16	6/32	12/64	·1875	·03515625	·006591796875
				13/64	·203125	·041259765625	·008380889892578125
			7/32	14/64	·21875	·0478515625	·010467529296875
				15/64	·234375	·054931640625	·012874603271484375
1/4	2/8	4/16	8/32	16/64	·25	·0625	·015625
				17/64	·265625	·070556640625	·018741607666015625
			9/32	18/64	·28125	·0791015625	·022247314453125
				19/64	·296875	·088134765625	·026165008544921875
		5/16	10/32	20/64	·3125	·09765625	·030517578125

VULGAR FRACTIONS, DECIMAL EQUIVALENTS, SQUARES AND CUBES.

Fractions.						Equivalents.	Squares.	Cubes.
					25/64	·390625	·152587890625	·059604644775390625
				13/32	26/64	·40625	·1650390625	·067047119140625
					27/64	·421875	·177978515625	·075084686279296875
			7/16	14/32	28/64	·4375	·19140625	·083740234375
					29/64	·453125	·205322265625	·093036651611328125
				15/32	30/64	·46875	·2197265625	·102996826171875
					31/64	·484375	·234619140625	·113643646240234375
½	2/4	4/8	8/16	16/32	32/64	·5	·25	·125
					33/64	·515625	·265869140625	·137088775634765625
				17/32	34/64	·53125	·2822265625	·149932861328125
					35/64	·546875	·299072265625	·163555145263671875
			9/16	18/32	36/64	·5625	·31640625	·177978515625
					37/64	·578125	·334228515625	·193225860595703125
				19/32	38/64	·59375	·3525590625	·209320068359375
					39/64	·609375	·371337890625	·226284027099609375
		5/8	10/16	20/32	40/64	·625	·390625	·244140625
					41/64	·640625	·410400390625	·262912730244140625
				21/32	42/64	·65625	·4306640625	·282623291015625
					43/64	·671875	·451416015625	·303295135498046875
			11/16	22/32	44/64	·6875	·47265625	·324951171875
					45/64	·703125	·494384765625	·347614288330078125
				23/32	46/64	·71875	·5166015625	·371307373046875
					47/64	·734375	·539306640625	·396053314208984375
	3/4	6/8	12/16	24/32	48/64	·75	·5625	·421875

TABLE No. 195.

NUMBERS, VULGAR FRACTIONS, DECIMAL EQUIVALENTS, SQUARES AND CUBES.

Fractions.					Equivalents.	Squares.	Cubes.
				49/64	·765625	·586181640625	·448795318603515625
			25/32	50/64	·78125	·6103515625	·476837158203125
				51/64	·796875	·635009765625	·506023406982421875
		13/16	26/32	52/64	·8125	·66015625	·536376953125
				53/64	·828125	·685791015625	·567920684814453125
			27/32	54/64	·84375	·7119140625	·600677490234375
				55/64	·859375	·738525390625	·634670257568359375
	7/8	14/16	28/32	56/64	·875	·765625	·669921875
				57/64	·890625	·793212890625	·706455230712890625
			29/32	58/64	·90625	·8212890625	·744293212890625
				59/64	·921875	·849853515625	·783458709716796875
		15/16	30/32	60/64	·9375	·87890625	·823974609375
				61/64	·953125	·908447265625	·865863800048828125
			31/32	62/64	·96875	·9384765625	·909149169921875
				63/64	·984375	·968994140625	·953853607177734375
1					1·0	1·0	1·0
1				1/64	1·015625	1·031494140625	1·047611236572265625
1			1/32	2/64	1·03125	1·0634765625	1·096710205078125
1				3/64	1·046875	1·095947265625	1·147319793701171875
1		1/16	2/32	4/64	1·0625	1·12890625	1·199462890625
1				5/64	1·078125	1·162353515625	1·253162384033203125
1			3/32	6/64	1·09375	1·1962890625	1·308441162109375
1	[illegible]	[illegible]	[illegible]	7/64	[illegible]		

Table No. 195a.

NUMBERS, VULGAR FRACTIONS, DECIMAL EQUIVALENTS, SQUARES AND CUBES.

Fractions.							Equivalents.	Squares.	Cubes.
1						9/64	1·140625	1·301025390625	1·483982086181640625
1					5/32	10/64	1·15625	1·3369140625	1·545806884765625
1						11/64	1·171875	1·373291015625	1·609325408935546875
1				3/16	6/32	12/64	1·1875	1·41015625	1·674560546875
1						13/64	1·203125	1·447509765625	1·741535186767578125
1					7/32	14/64	1·21875	1·4853515625	1·810272216796875
1						15/64	1·234375	1·523681640625	1·880794525146484375
1		1/4	2/8	4/16	8/32	16/64	1·25	1·5625	1·953125
1						17/64	1·265625	1·601806640625	2·027286529541015625
1					9/32	18/64	1·28125	1·6416015625	2·103302001953125
1						19/64	1·296875	1·681884765625	2·181194305419921875
1				5/16	10/32	20/64	1·3125	1·72265625	2·260986328125
1						21/64	1·328125	1·763916015625	2·342700958251953125
1					11/32	22/64	1·34375	1·8056640625	2·426361083984375
1						23/64	1·359375	1·847900390625	2·511989593505859375
1			3/8	6/16	12/32	24/64	1·375	1·890625	2·599609375
1						25/64	1·390625	1·933837890625	2·689243316650390625
1					13/32	26/64	1·40625	1·9775390625	2·780914306640625
1						27/64	1·421875	2·021728515625	2·874645233154296875
1				7/16	14/32	28/64	1·4375	2·06640625	2·970458984375
1						29/64	1·453125	2·111572265625	3·068378448486328125
1					15/32	30/64	1·46875	2·1572265625	3·168426513671875
1						31/64	1·484375	2·203369140625	3·270626068115234375
1	1/2	2/4	4/8	8/16	16/32	32/64	1·5	2·25	3·375

NUMBERS, VULGAR FRACTIONS, DECIMAL EQUIVALENTS, SQUARES AND CUBES.

	Fractions.					Equivalents.	Squares.	Cubes.
1					33/64	1·515625	2·297119140625	3·481571197509765625
1				17/32	34/64	1·53125	2·3447265625	3·590362548828125
1					35/64	1·546875	2·392822265625	3·701396942138671875
1			9/16	18/32	36/64	1·5625	2·44140625	3·814697265625
1					37/64	1·578125	2·490478515625	3·930286407470703125
1				19/32	38/64	1·59375	2·5400390625	4·048187255859375
1					39/64	1·609375	2·590087890625	4·168422698974609375
1		5/8	10/16	20/32	40/64	1·625	2·640625	4·291015625
1					41/64	1·640625	2·691650390625	4·415988922119140625
1				21/32	42/64	1·65625	2·7431640625	4·543365478515625
1					43/64	1·671875	2·795166015625	4·673168182373046875
1			11/16	22/32	44/64	1·6875	2·84765625	4·805419921875
1					45/64	1·703125	2·900634765625	4·940143585205078125
1				23/32	46/64	1·71875	2·9541015625	5·077362060546875
1					47/64	1·734375	3·008056640625	5·217098236083984375
1	3/4	6/8	12/16	24/32	48/64	1·75	3·0625	5·359375
1					49/64	1·765625	3·117431640625	5·504215240478515625
1				25/32	50/64	1·78125	3·1728515625	5·651641845703125
1					51/64	1·796875	3·228759765625	5·801677703857421875
1			13/16	26/32	52/64	1·8125	3·28515625	5·954345703125
1					53/64	1·828125	3·342041015625	6·109668731689453125
1				27/32	54/64	1·84375	3·3994140625	6·267669677734375
1					55/64	1·859375	3·457275390625	6·428371429443359375
1		7/8	14/16	28/32	56/64	1·875	3·515625	6·591796875

TABLE No. 196a.

NUMBERS, VULGAR FRACTIONS, DECIMAL EQUIVALENTS, SQUARES AND CUBES.

Fractions.							Equivalents.	Squares.	Cubes.
1						57/64	1·890625	3·574462890625	6·757968902587890625
1					29/32	58/64	1·90625	3·6337890625	6·926910400390625
1						59/64	1·921875	3·693603515625	7·098644256591796875
1				15/16	30/32	60/64	1·9375	3·75390625	7·273193359375
1						61/64	1·953125	3·814697265625	7·450580596923828125
1					31/32	62/64	1·96875	3·8759765625	7·630828857421875
1						63/64	1·984375	3·937744140625	7·813961029052734375
2							2	4	8
2					1/32		2·03125	4·1259765625	8·380889892578125
2				1/16	2/32		2·0625	4·25390625	8·773681640625
2					3/32		2·09375	4·3837890625	9·178558349609375
2			1/8	2/16	4/32		2·125	4·515625	9·595703125
2					5/32		2·15625	4·6494140625	10·025299072265625
2				3/16	6/32		2·1875	4·78515625	10·467529296875
2					7/32		2·21875	4·9228515625	10·922576904296875
2		1/4	2/8	4/16	8/32		2·25	5·0625	11·390625
2					9/32		2·28125	5·2041015625	11·871856689453125
2				5/16	10/32		2·3125	5·34765625	12·366455078125
2					11/32		2·34375	5·4931640625	12·874603271484375
2			3/8	6/16	12/32		2·375	5·640625	13·396484375
2					13/32		2·40625	5·7900390625	13·932281494140625
2				7/16	14/32		2·4375	5·94140625	14·482177734375
2					15/32		2·46875	6·0947265625	15·046356201171875
2	1/2	2/4	4/8	8/16	16/32		2·5	6·25	15·625
2					17/32		2·53125	6·4072265625	16·218292236328125

TABLE No. 197.

NUMBERS, VULGAR FRACTIONS, DECIMAL EQUIVALENTS, SQUARES AND CUBES.

	Fractions.				Equivalents.	Squares.	Cubes.
2			9/16	18/32	2·5625	6·56640625	16·826416015625
2				19/32	2·59375	6·7275390625	17·449554443359375
2		5/8	10/16	20/32	2·625	6·890625	18·087890625
2				21/32	2·65625	7·0556640625	18·741607666015625
2			11/16	22/32	2·6875	7·22265625	19·410888671875
2				23/32	2·71875	7·3916015625	20·095916748046875
2	3/4	6/8	12/16	24/32	2·75	7·5625	20·796875
2				25/32	2·78125	7·7353515625	21·513946533203125
2			13/16	26/32	2·8125	7·91015625	22·247314453125
2				27/32	2·84375	8·0869140625	22·997161865234375
2		7/8	14/16	28/32	2·875	8·265625	23·763671875
2				29/32	2·90625	8·4462890625	24·547027587890625
2			15/16	30/32	2·9375	8·62890625	25·347412109375
2				31/32	2·96875	8·8134765625	26·165008544921875
3					3	9	27
3				1/32	3·03125	9·1884765625	27·852569580078125
3			1/16	2/32	3·0625	9·37890625	28·722900390625
3				3/32	3·09375	9·5712890625	29·611175537109375
3		1/8	2/16	4/32	3·125	9·765625	30·517578125
3				5/32	3·15625	9·9619140625	31·442291259765625
3			3/16	6/32	3·1875	10·1601562	32·385498046875
3				7/32	3·21875	10·3603515625	33·347381591796875
3	1/4	2/8	4/16	8/32	3·25	10·5625	34·328125
3				9/32	3·28125	10·7666015625	35·327911376953125
3			5/16	10/32	3·3125	10·97265625	36·346923828125

NUMBERS, VULGAR FRACTIONS, SQUARES AND CUBES.

Numbers and Fractions.	Squares.	Cubes.	Numbers and Fractions.	Squares.	Cubes.	Numbers and Fractions.	Squares.	Cubes.
3 11/32	11·181	37·385	4 1/8	17·016	70·189	4 29/32	24·071	118·100
3 3/8	11·391	38·443	4 5/32	17·274	71·797	4 15/16	24·379	120·371
3 13/32	11·603	39·521	4 3/16	17·535	73·428	4 31/32	24·688	122·671
3 7/16	11·816	40·619	4 7/32	17·798	75·085	5	25	125
3 15/32	12·032	41·737	4 1/4	18·062	76·766	5 1/32	25·313	127·358
3 1/2	12·25	42·875	4 9/32	18·329	78·471	5 1/16	25·629	129·746
3 17/32	12·470	44·034	4 5/16	18·598	80·202	5 3/32	25·946	132·164
3 9/16	12·691	45·213	4 11/32	18·868	81·959	5 1/8	26·266	134·611
3 19/32	12·915	46·413	4 3/8	19·141	83·740	5 5/32	26·587	137·089
3 5/8	13·141	47·635	4 13/32	19·415	85·548	5 3/16	26·910	139·596
3 21/32	13·368	48·877	4 7/16	19·691	87·381	5 7/32	27·235	142·134
3 11/16	13·598	50·141	4 15/32	19·970	89·240	5 1/4	27·562	144·703
3 23/32	13·829	51·427	4 1/2	20·25	91·125	5 9/32	27·892	147·303
3 3/4	14·062	52·734	4 17/32	20·532	93·037	5 5/16	28·223	149·933
3 25/32	14·298	54·064	4 9/16	20·816	94·975	5 11/32	28·556	152·594
3 13/16	14·535	55·415	4 19/32	21·103	96·940	5 3/8	28·891	155·287
3 27/32	14·774	56·789	4 5/8	21·391	98·932	5 13/32	29·228	158·011
3 7/8	15·016	58·186	4 21/32	21·681	100·951	5 7/16	29·566	160·767
3 29/32	15·259	59·605	4 11/16	21·973	102·997	5 15/32	29·907	163·555
3 15/16	15·504	61·047	4 23/32	22·267	105·071	5 1/2	30·25	166·375
3 31/32	15·751	62·512	4 3/4	22·562	107·172	5 17/32	30·595	169·227
4	16	64	4 25/32	22·860	109·301	5 9/16	30·941	172·112
4 1/32	16·251	65·512	4 13/16	23·160	111·458	5 19/32	31·290	175·029
4 1/16	16·504	67·047	4 27/32	23·462	113·644	5 5/8	31·641	177·979
4 3/32	16·759	68·606	4 7/8	23·766	115·857	5 21/32	31·993	180·961

NUMBERS, VULGAR FRACTIONS, SQUARES AND CUBES. Table No. 198.

Numbers and Fractions.	Squares.	Cubes.	Numbers and Fractions.	Squares.	Cubes.	Numbers and Fractions.	Squares.	Cubes.
5 11/16	32·348	183·977	6 15/16	48·129	333·894	8 1/2	72·25	614·125
5 23/32	32·704	187·027	7	49	343	8 9/16	73·316	627·772
5 3/4	33·062	190·109	7 1/16	49·879	352·270	8 5/8	74·391	641·619
5 25/32	33·423	193·226	7 1/8	50·766	361·705	8 11/16	75·473	655·669
5 13/16	33·785	196·376	7 3/16	51·660	371·307	8 3/4	76·562	669·922
5 27/32	34·149	199·561	7 1/4	52·562	381·078	8 13/16	77·660	684·380
5 7/8	34·516	202·779	7 5/16	53·473	391·019	8 7/8	78·766	699·045
5 29/32	34·884	206·032	7 3/8	54·391	401·131	8 15/16	79·879	713·918
5 15/16	35·254	209·320	7 7/16	55·316	411·416	9	81	729
5 31/32	35·626	212·643	7 1/2	56·25	421·875	9 1/16	82·129	744·293
6	36	216	7 9/16	57·191	432·510	9 1/8	83·266	759·799
6 1/16	36·754	222·821	7 5/8	58·141	443·322	9 3/16	84·410	775·518
6 1/8	37·516	229·783	7 11/16	59·098	454·313	9 1/4	85·562	791·453
6 3/16	38·285	236·889	7 3/4	60·062	465·484	9 5/16	86·723	807·605
6 1/4	39·062	244·141	7 13/16	61·035	476·837	9 3/8	87·891	823·975
6 5/16	39·848	251·538	7 7/8	62·016	488·373	9 7/16	89·066	840·564
6 3/8	40·641	259·084	7 15/16	63·004	500·094	9 1/2	90·25	857·375
6 7/16	41·441	266·779	8	64	512	9 9/16	91·441	874·408
6 1/2	42·25	274·625	8 1/16	65·004	524·094	9 5/8	92·641	891·666
6 9/16	43·066	282·623	8 1/8	66·016	536·377	9 11/16	93·848	909·149
6 5/8	43·891	290·775	8 3/16	67·035	548·850	9 3/4	95·062	926·859
6 11/16	44·723	299·083	8 1/4	68·062	561·516	9 13/16	96·285	944·798
6 3/4	45·562	307·547	8 5/16	69·098	574·374	9 7/8	97·516	962·967
6 13/16	46·410	316·169	8 3/8	70·141	587·428	9 15/16	98·754	981·367
6 7/8	47·266	324·951	8 7/16	71·191	600·677	10	100	1000

NUMBERS, VULGAR FRACTIONS, SQUARES AND CUBES. TABLE No. 198a.

Numbers and Fractions.	Squares.	Cubes.	Numbers and Fractions.	Squares.	Cubes.	Numbers and Fractions.	Squares.	Cubes.
10 1/16	101·254	1018·867	11 5/8	135·141	1571·010	14 3/8	206·641	2970·459
10 1/8	102·516	1037·971	11 11/16	136·598	1596·485	14 1/2	210·25	3048·625
10 3/16	103·785	1057·311	11 3/4	138·062	1622·234	14 5/8	213·891	3128·150
10 1/4	105·062	1076·891	11 13/16	139·535	1648·259	14 3/4	217·562	3209·047
10 5/16	106·348	1096·710	11 7/8	141·016	1674·561	14 7/8	221·266	3291·326
10 3/8	107·641	1116·771	11 15/16	142·504	1701·140	15	225	3375
10 7/16	108·941	1137·076	12	144	1728	15 1/8	228·766	3460·080
10 1/2	110·25	1157·625	12 1/8	147·016	1782·564	15 1/4	232·562	3546·578
10 9/16	111·566	1178·420	12 1/4	150·062	1838·266	15 3/8	236·391	3634·506
10 5/8	112·891	1199·463	12 3/8	153·141	1895·115	15 1/2	240·25	3723·875
10 11/16	114·223	1220·755	12 1/2	156·25	1953·125	15 5/8	244·141	3814·697
10 3/4	115·562	1242·297	12 5/8	159·391	2012·307	15 3/4	248·062	3906·984
10 13/16	116·910	1264·091	12 3/4	162·562	2072·672	15 7/8	252·016	4000·748
10 7/8	118·266	1286·139	12 7/8	165·766	2134·232	16	256	4096
10 15/16	119·629	1308·441	13	169	2197	16 1/8	260·016	4192·752
11	121	1331	13 1/8	172·266	2260·986	16 1/4	264·062	4291·016
11 1/16	122·379	1353·817	13 1/4	175·562	2326·203	16 3/8	268·141	4390·803
11 1/8	123·766	1376·893	13 3/8	178·891	2392·662	16 1/2	272·25	4492·125
11 3/16	125·160	1400·229	13 1/2	182·25	2460·375	16 5/8	276·391	4594·994
11 1/4	126·562	1423·828	13 5/8	185·641	2529·354	16 3/4	280·562	4699·422
11 5/16	127·973	1447·691	13 3/4	189·062	2599·609	16 7/8	284·766	4805·420
11 3/8	129·391	1471·818	13 7/8	192·516	2671·154	17	289	4913

NUMBERS, VULGAR FRACTIONS, SQUARES AND CUBES.

Numbers and Fractions.	Squares.	Cubes.	Numbers and Fractions.	Squares.	Cubes.	Numbers and Fractions.	Squares.	Cubes.
17½	306·25	5359·375	20¾	430·562	8934·172	24	576	13824
17⅝	310·641	5475·041	20⅞	435·766	9096·607	24¼	588·062	14260·516
17¾	315·062	5592·359	21	441	9261	24½	600·25	14706·125
17⅞	319·516	5711·342	21⅛	446·266	9427·361	24¾	612·562	15160·922
18	324	5832	21¼	451·562	9595·703	25	625	15625
18⅛	328·516	5954·346	21⅜	456·891	9766·037	25¼	637·562	16098·453
18¼	333·062	6078·391	21½	462·25	9938·375	25½	650·25	16581·375
18⅜	337·641	6204·146	21⅝	467·641	10112·729	25¾	663·062	17073·859
18½	342·25	6331·625	21¾	473·062	10289·109	26	676	17576
18⅝	346·891	6460·838	21⅞	478·516	10467·529	26¼	689·062	18087·891
18¾	351·562	6591·797	22	484	10648	26½	702·25	18609·625
18⅞	356·266	6724·514	22⅛	489·516	10830·533	26¾	715·562	19141·297
19	361	6859	22¼	495·062	11015·141	27	729	19683
19⅛	365·766	6995·268	22⅜	500·641	11201·834	27¼	742·562	20234·828
19¼	370·562	7133·328	22½	506·25	11390·625	27½	756·25	20796·875
19⅜	375·391	7273·193	22⅝	511·891	11581·525	27¾	770·062	21369·234
19½	380·25	7414·875	22¾	517·562	11774·547	28	784	21952
19⅝	385·141	7558·385	22⅞	523·266	11969·701	28¼	798·062	22545·266
19¾	390·062	7703·734	23	529	12167	28½	812·25	23149·125
19⅞	395·016	7850·936	23⅛	534·766	12366·455	28¾	826·562	23763·672
20	400	8000	23¼	540·562	12568·078	29	841	24389
20⅛	405·016	8150·939	23⅜	546·391	12771·881	29¼	855·562	25025·203
[illegible]	[illegible]	[illegible]	[illegible]	552·25	12977·875	29½	870·25	25672·375

INCHES AND THEIR EQUIVALENT DECIMALS OF A FOOT. TABLE No. 200.

Inches	Equivalents.	Inches	Equivalents.	Inches.	Equivalents.	Inches.	Equivalents.	Inches.	Equivalents.
[illegible]	[illegible]	[illegible]	[illegible]	39/64	·05078125	29/32	·07552083	1 13/32	·1171875
[illegible]	[illegible]	[illegible]	[illegible]	5/8	·052083	59/64	·076822916	1 7/16	·1197916
[illegible]	[illegible]	[illegible]	[illegible]	41/64	·053385416	15/16	·078125	1 15/32	·12239583
[illegible]	[illegible]	[illegible]	[illegible]	21/32	·0546875	61/64	·079427083	1 1/2	·125
[illegible]	[illegible]	[illegible]	[illegible]	43/64	·055989583	31/32	·08072916	1 17/32	·12760416
[illegible]	[illegible]	[illegible]	[illegible]	11/16	·0572916	63/64	·08203125	1 9/16	·1302083
[illegible]	[illegible]	[illegible]	[illegible]	45/64	·05859375	1	·083	1 19/32	·1328125
[illegible]	[illegible]	[illegible]	[illegible]	23/32	·059895833	1 1/32	·0859375	1 5/8	·135416
[illegible]	[illegible]	[illegible]	[illegible]	47/64	·061197916	1 1/16	·0885416	1 21/32	·13802083
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 3/32	·09114583	1 11/16	·140625
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 1/8	·09375	1 23/32	·14322916
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 5/32	·09635416	1 3/4	·14583
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 3/16	·09895833	1 25/32	·1484375
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 7/32	·1015625	1 13/16	·1510416
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 1/4	·10416	1 27/32	·15364583
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 7/8	·15625
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 29/32	·15885416
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 15/16	·1614583
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 31/32	·1640625

[illegible]

INCHES AND THEIR EQUIVALENT DECIMALS OF A FOOT. TABLE No. 200—*continued.*

Inches.	Equivalents.	Inches.	Equivalents.	Inches.	Equivalents.	Inches.	Equivalents.	Inches.	Equivalents.
2	·16	3¼	·27083	5½	·4583	7¾	·64583	10	·8333
2 1/16	·171875	3⅜	·28125	5⅝	·46875	7⅞	·65625	10⅛	·84375
2 ⅛	·177083	3½	·2916	5¾	·47916	8	·6666	10¼	·85416
2 3/16	·1822916	3⅝	·302083	5⅞	·489583	8⅛	·677083	10⅜	·864583
2 ¼	·1875	3¾	·3125	6	·5	8¼	·6875	10½	·875
2 5/16	·1927083	3⅞	·322916	6⅛	·510416	8⅜	·697916	10⅝	·885416
2 ⅜	·197916	4	·3333	6¼	·52083	8½	·7083	10¾	·89583
2 7/16	·203125	4⅛	·34375	6⅜	·53125	8⅝	·71875	10⅞	·90625
2 ½	·2083	4¼	·35416	6½	·5416	8¾	·72916	11	·916
2 9/16	·2135416	4⅜	·364583	6⅝	·552083	8⅞	·739583	11⅛	·927083
2 ⅝	·21875	4½	·375	6¾	·5625	9	·75	11¼	·9375
2 11/16	·2239583	4⅝	·385416	6⅞	·572916	9⅛	·760416	11⅜	·947916
2 ¾	·22916	4¾	·39583	7	·583	9¼	·77083	11½	·9583
2 13/16	·234375	4⅞	·40625	7¼	·59375	9⅜	·78125	11⅝	·96875

[illegible] THEIR APPROXIMATE VALUES, &c., IN VULGAR FRACTIONS. TABLE No. 201.
From ·01 to ·99 advancing by ·01.

Decimals.	Nearest Vulgar Fractions.	Greater than	Less than	Decimals.	Nearest Vulgar Fractions.	Greater than	Less than	Decimals.	Nearest Vulgar Fractions.	Greater than	Less than	Decimals.	Nearest Vulgar Fractions.	Greater than	Less than	Decimals.	Nearest Vulgar Fractions.	Greater than	Less than
·01	1/64	...	1/64	·21	13/64	13/64	7/32	·41	13/32	13/32	27/64	·61	39/64	39/64	5/8	·81	13/16	51/64	13/16
·02	1/64	1/64	1/32	·22	7/32	7/32	15/64	·42	27/64	13/32	27/64	·62	5/8	39/64	5/8	·82	53/64	13/16	53/64
·03	1/32	1/64	1/32	·23	15/64	7/32	15/64	·43	7/16	27/64	7/16	·63	5/8	5/8	41/64	·83	53/64	53/64	27/32
·04	3/64	1/32	3/64	·24	15/64	15/64	1/4	·44	7/16	7/16	29/64	·64	41/64	5/8	41/64	·84	27/32	53/64	27/32
·05	3/64	3/64	1/16	·25	1/4	...	...	·45	29/64	7/16	29/64	·65	21/32	41/64	21/32	·85	27/32	27/32	55/64
·06	1/16	3/64	1/16	·26	17/64	1/4	17/64	·46	29/64	29/64	15/32	·66	21/32	21/32	43/64	·86	55/64	55/64	7/8
·07	1/16	1/16	5/64	·27	17/64	17/64	9/32	·47	15/32	15/32	31/64	·67	43/64	21/32	43/64	·87	7/8	55/64	7/8
·08	5/64	5/64	3/32	·28	9/32	17/64	9/32	·48	31/64	15/32	31/64	·68	11/16	43/64	11/16	·88	7/8	7/8	57/64
·09	3/32	5/64	3/32	·29	19/64	9/32	19/64	·49	31/64	31/64	1/2	·69	11/16	11/16	45/64	·89	57/64	7/8	57/64
·1	3/32	3/32	7/64	·3	19/64	19/64	5/16	·5	1/2	...	...	·7	45/64	11/16	45/64	·9	[illegible]	[illegible]	[illegible]
·11	7/64	7/64	1/8	·31	5/16	19/64	5/16	·51	33/64	1/2	33/64	·71	45/64	45/64	23/32	·91	[illegible]	[illegible]	[illegible]
·12	1/8	7/64	1/8	·32	5/16	5/16	21/64	·52	33/64	33/64	17/32	·72	[illegible]	[illegible]	[illegible]	·92	[illegible]	[illegible]	[illegible]
·13	1/8	1/8	9/64	·33	21/64	21/64	11/32	·53	17/32	33/64	17/32	·73	[illegible]	[illegible]	[illegible]	·93	[illegible]	[illegible]	[illegible]
·14	9/64	1/8	9/64	·34	11/32	21/64	11/32	·54	35/64	17/32	35/64	·74	[illegible]	[illegible]	[illegible]	·94	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	9/64	5/32	·35	11/32	11/32	23/64	·55	35/64	35/64	9/16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	11/64	·36	23/64	23/64	3/8	·56	9/16	35/64	9/16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	11/64	·37	3/8	23/64	3/8	·57	9/16	9/16	37/64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
·18	[illegible]	[illegible]	[illegible]	·38	3/8	3/8	25/64	·58	37/64	9/16	37/64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	·39	25/64	3/8	25/64	·59	19/32	37/64	19/32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	·4	13/32	25/64	13/32	·6	19/32	19/32	39/64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Th[illegible] convenient for converting [illegible] values into vulgar fractions.

FOURTH POWERS.

The fourth powers as given in the following Table, No. 202, in the columns headed Fourth Powers, are complete for the whole numbers, and also for all the others *except* when the fourth or terminal decimal is 4 or 9.

When the fourth or terminal decimal in the column headed Fourth Powers is 4 or 9, if 0625 be placed after the last figure, 4 or 9 as the case may be, the fourth power is completed; but in many cases the fourth power, as given to four decimals, is sufficiently accurate.

The following notes will facilitate calculating the fourth powers of numbers not given in the table :—

The fourth power of any given number, multiplied by 16, equals the fourth power of double the given number.

The fourth power of a given number, divided by 16, equals the fourth power of half the given number.

The fourth power of a number, multiplied by 81, equals the fourth power of three times the given number.

The fourth power of a number, divided by 81, equals the fourth power of one third the given number.

Or the following embraces all cases :—

If N equals any given number and F equals the fourth power of N, the fourth power of any multiple of N may be found by multiplying F by the fourth power of the given multiple of N; for example :—

If the multiple of N be 2, multiply F by 16, which is the fourth power of 2; if 3 N by 81, which is the fourth power of 3; and if the multiple of N be 10, F should be multiplied by 10000, as it is the fourth power of 10.

The fourth power table among other uses may be found convenient when dealing with spiral springs.

FOURTH POWERS.

Nos.	Fourth Powers.	Nos.	Fourth Powers.	Nos.	Fourth Powers.
1	1	11·5	17490·0625	22	234256
1·25	2·4414	11·75	19061·2539	22·25	245086·8789
1·5	5·0625	12	20736	22·5	256289·0625
1·75	9·3789	12·25	22518·7539	22·75	267870·9414
2	16	12·5	24414·0625	23	279841
2·25	25·6289	12·75	26426·5664	23·25	292207·8164
2·5	39·0625	13	28561	23·5	304980·0625
2·75	57·1914	13·25	30822·1914	23·75	318166·5039
3	81	13·5	33215·0625	24	331776
3·25	111·5664	13·75	35744·6289	24·25	345817·5039
3·5	150·0625	14	38416	24·5	360300·0625
3·75	197·7539	14·25	41234·3789	24·75	375232·8164
4	256	14·5	44205·0625	25	390625
4·25	326·2539	14·75	47333·4414	25·25	406485·9414
4·5	410·0625	15	50625	25·5	422825·0625
4·75	509·0664	15·25	54085·3164	25·75	439651·8789
5	625	15·5	57720·0625	26	456976
5·25	759·6914	15·75	61535·0039	26·25	474807·1289
5·5	915·0625	16	65536	26·5	493155·0625
5·75	1093·1289	16·25	69729·0039	26·75	512029·6914
6	1296	16·5	74120·0625	27	531441
6·25	1525·8789	16·75	78715·3164	27·25	551399·0664
6·5	1785·0625	17	83521	27·5	571914·0625
6·75	2075·9414	17·25	88543·4414	27·75	592996·2539
7	2401	17·5	93789·0625	28	614656
7·25	2762·8164	17·75	99264·3789	28·25	636903·7539
7·5	3164·0625	18	104976	28·5	659750·0625
7·75	3607·5039	18·25	110930·6289	28·75	683205·5664
8	4096	18·5	117135·0625	29	707281
8·25	4632·5039	18·75	123596·1914	29·25	731987·1914
8·5	5220·0625	19	130321	29·5	757335·0625
8·75	5861·8164	19·25	137316·5664	29·75	783335·6289
9	6561	19·5	144590·0625	30	810000
9·25	7320·9414	19·75	152148·7539	30·25	837339·3789
9·5	8145·0625	20	160000	30·5	865365·0625
9·75	9036·8789	20·25	168151·2539	30·75	894088·4414
10	10000	20·5	176610·0625	31	923521
10·25	11038·1289	20·75	185384·0664	31·25	953674·3164
10·5	12155·0625	21	194481	31·5	984560·0625
10·75	13354·6914	21·25	203908·6914	31·75	1016190·0039
11	14641	21·5	213675·0625	32	1048576
11·25	16018·0664	21·75	223788·1289		

WEIGHTS AND MEASURES, &c.

Following these notes are Tables of Imperial and Metric Weights and Measures and equivalents.

There is a bronze bar deposited in London which is marked, and the standard yard is based on the distance between these marks when the bar is at the temperature of 62 degrees Fahrenheit, or about 16·66 degrees Centigrade, or about 13·33 degrees Réaumur.

A piece of platinum, which is also deposited in London, is taken as the standard pound, when weighed *in vacuo* at the temperature of 32 degrees Fahrenheit, or 0 degrees Centigrade, or 0 degrees Réaumur.

A cubic foot of distilled water weighs 62·321 lbs.

A gallon of distilled water weighs 10 lbs., or about 4·5359265 kilogrammes, when the barometer is at 30 inches, or about 761·9862339 millimetres, in the latitude of London at about the sea level, and the temperature is at 62 degrees Fahrenheit, or 13·33 degrees Réaumur, or 16·66 degrees Centigrade.

The weight of a cubic inch of distilled water is taken at 252·458 grains.

The capacity of a gallon is taken at 277·274 cubic inches.

For ordinary purposes, *not legal equivalents*, the weight of a cubic foot of fresh water, not distilled, may be taken at 62·5 lbs., and the weight of a cubic foot of sea water at 64 lbs., and a ton of sea water may be considered as equal to 35 cubic feet, and to about 218·12 gallons, and a cubic foot to about 6·232 gallons.

In Paris there is a platinum bar, known as the "Mètre des Archives," and when the bar is at the temperature of 0 degrees Centigrade, or 0 degrees Réaumur, or 32 degrees Fahrenheit, it is taken as the length of the metre.

39·37079 inches is the legal equivalent of the metre, but were a brass metre compared at the temperature of 62 degrees Fahrenheit (and not at 0 degrees Centigrade, which is the legal temperature) with a bronze yard at the same temperature, viz., 62 degrees Fahrenheit, the apparent equivalent of the metre is nearly 39·382 inches.

A piece of platinum deposited in Paris, known as the "Kilogramme des Archives," when weighed *in vacuo* at 0 degrees Centigrade, or 0 degrees Réaumur, or 32 degrees Fahrenheit, is taken as the weight of the kilogramme.

The litre, or cubic decimetre, when the barometer is at 760 millimetres, or about 29·9218004 inches, contains one kilogramme weight of distilled water at its maximum density of 4 degrees Centigrade, or 3·2 degrees Réaumur, or 39·2 degrees Fahrenheit.

Imperial and Metric Weights and Measures.

Linear Measure.

, ...	=	25·39954113 millimetres.
(12 inches), ...	=	·30479449 metre.
(3 feet), ...	=	·91438348 ,,
(5½ yards), ...	=	5·02911 metres.
n (22 yards or 100 links),	=	20·11644 ,,
ng (220 yards), . . .	=	201·16437 ,,
(1760 yards), ...	=	1·60931493 kilometres.

Square Measure.

re inch, ...	=	6·45137 square centimetres.
re foot (144 square inches),	=	9·28997 square decimetres.
re yard (9 square feet), .	=	·83609715 square metre.
ı (30¼ square yards), .	=	25·29194 ,,
(40 perches), ...	=	10·11678 acres.
(4840 square yards), .	=	·40467 hectare.
re mile (640 acres), .	=	258·98945312 hectares.

Cubic Measure.

c inch, ...	=	16·38617589 cubic centimetres.
c foot (1728 cubic inches),	=	·02832 cubic metre, or 28·31531 cubic decimetres.
c yard (27 cubic feet), .	=	·76451342 cubic metre.

Apothecaries' Measure.

on* (8 pints or 160 fluid nces), ...	=	4·54346 litres.
l ounce f℥ (8 drachms), .	=	28·39661 cubic centimetres.
l drachm, fʒ (60 minims),	=	3·54958 ,,
ıim, ♏ (0·91146 grain ight), ...	=	·05916 ,,

Measure of Capacity.

. . . .	=	1·41983 decilitres.
(4 gills), ...	=	·56793 litre.
t (2 pints), ...	=	1·13586 litres.
n (4 quarts), ...	=	4·54345797 litres.
(2 gallons), ...	=	9·08692 ,,
el (8 gallons), ...	=	8·63477 dekalitres.
ter (8 bushels), . . .	=	2·90781 hectolitres.

apothecaries' gallon is of the same capacity as the imperial gallon.

Avoirdupois Weight.

1 Grain, ...	=	64·79895036 milligrammes
1 Drachm, ...	=	1·77185 grammes.
1 Ounce (16 drachms), . . .	=	28·34954 ,,
1 Pound (16 ounces or 7000 grains),	=	·45359265 kilogramme.
1 Stone (14 pounds), . . .	=	6·35030 ,,
1 Quarter (28 pounds), . . .	=	12·70059 ,,
1 Hundredweight (112 lbs.), .	=	50·80238 ,, or ·50802 quintal.
1 Ton (20 cwt.), ...	=	1·01604754 millier or tonn

Troy Weight.

1 Troy ounce (480 grains* avoirdupois), ...	=	31·10350 grammes.
1 Pennyweight (24 grains*), .	=	1·55517 ,,

Apothecaries' Weight.

1 Ounce† (8 drachms), . . .	=	31·10350 grammes.
1 Drachm ʒi (3 scruples), . .	=	3·88794 ,,
1 Scruple ℈i (20 grains), . .	=	1·29598 ,,

Metric and Imperial Weights and Measures.

Linear Measure.

1 Millimetre (·001 m.), . . .	=	·03937 inch.
1 Centimetre (·01 ,,), . . .	=	·39371 ,,
1 Decimetre (·1 ,,), . . .	=	3·93708 inches
1 Metre, ...	=	39·37079 ,, 3·28089917 feet. 1·09363306 yards.
1 Decametre (10 m.), . .	=	10·93633 ,,
1 Hectometre (100 ,,), . .	=	109·36331 ,,
1 Kilometre (1000 ,,), . .	=	·62138 mile.
1 Myriameter (10000 ,,), . .	=	6·21382 miles.
1 Micron, ...	=	·001 mm.

Square Measure.

1 Square centimetre, ...	=	·15501 square inch.
1 Square decimeter (100 square centimetres), ...	=	15·50059 square inches.
1 Square metre or centiare (100 square decimetres), . .	=	10·76430 square feet. 1·19603 square yards.
1 Are (100 square metres), . .	=	119·60333 square yards.
1 Hectare (100 ares or 10000 square metres), . . .	=	2·47114 acres.

* The troy grain is of the same weight as the avoirdupois grain.
† The apothecaries' ounce is of the same weight as the troy ounce apothecaries' grain is also of the same weight as the avoirdupois grain.

Cubic Measure.

1 Cubic centimetre (1000 cubic millimetres), ...	=	·06103 cubic inch.
1 Cubic decimetre (1000 cubic centimetres), ...	=	61·02705 cubic inches.
1 Cubic metre or stere (1000 cubic decimetres), . .	=	35·31658074 cubic feet. 1·30802151 cubic yard

Measure of Capacity.

1 Centilitre (·01 litre), . .	=	·07043 gill.
1 Decilitre (·1 „), . .	=	·17608 pint.
1 Litre or 1000 cubic centimetres or 1 cubic decimetre, . .	=	1·76077 pints.
1 Dekalitre (10 litres), . .	=	2·20097 gallons.
1 Hectolitre (100 „), . .	=	2·75121 bushels.
1 Kilolitre (1000 „), . .	=	3·43901 quarters

Apothecaries' Measure.

1 Cubic centimetre, or 1 gramme weight, ...	=	·03527 fluid ounce. ·28219 fluid drachm, or 15·43235 grains weight.
1 Cubic millimetre, ...	=	·01693 minim

Weight.		*Avoirdupois.*
1 Milligramme (·001 gramme), .	=	·01543 grain.
1 Centigramme (·01 „), .	=	·15432 „
1 Deçigramme (·1 „), .	=	1·54324 grains.
1 Gramme, ...	=	15·43235 „
1 Dekagramme (10 grammes),	=	5·64383 drams.
1 Hectogramme (100 „),	=	3·52739 ounces.
1 Kilogramme (1000 „),	=	2·20462125 lbs., or 15432·34874 grains.
1 Myriagramme (10 kilos.), .	=	22·04621 lbs.
1 Quintal (100 „), .	=	1·96841 cwt.
1 Millier or tonne (1000 „), .	=	·98420591 ton.
		Troy.
1 Gramme, ...	=	·03215073 ounce troy. ·64301 pennyweight. 15·43235 grains.
		Apothecaries'.
1 Gramme, ...	=	·25721 drachm. ·77162 scruple. 15·43235 grains.

IMPERIAL AND METRIC WEIGHTS AND MEASURES, EQUIVALENTS.

Linear Measure.

	Inches to Millimetres.	Feet to Metres.	Yards to Metres.	Miles to Kilometres.
1=	25·39954113	·30479	·91438	1·60931
2=	50·79908226	·60959	1·82877	3·21863
3=	76·19862340	·91438	2·74315	4·82794
4=	101·59816453	1·21918	3·65753	6·43726
5=	126·99770566	1·52397	4·57192	8·04657
6=	152·39724679	1·82876	5·48630	9·65589
7=	177·79678792	2·13356	6·40068	11·26520
8=	203·19632906	2·43835	7·31507	12·87452
9=	228·59587019	2·74315	8·22945	14·48383

Square Measure.

	Square Inches to Square Centimetres.	Square Feet to Square Decimetres.	Square Yards to Square Metres.	Acres to Hectares.
1=	6·45137	9·28997	·83610	·40467
2=	12·90273	18·57994	1·67219	·80934
3=	19·35410	27·86990	2·50829	1·21401
4=	25·80547	37·15987	3·34439	1·61868
5=	32·25683	46·44984	4·18049	2·02336
6=	38·70820	55·73981	5·01658	2·42803
7=	45·15957	63·02978	5·85268	2·83270
8=	51·61094	74·31974	6·68878	3·23737
9=	58·06230	83·60971	7·52487	3·64204

	Cubic Measure			Apothecaries' Measure.
	Cubic Inches to Cubic Centimetres.	Cubic Feet to Cubic Metres.	Cubic Yards to Cubic Metres.	Fluid Drachms to Cubic Centimetres.
1=	16·38618	·02832	·76451	3·54958
2=	32·77235	·05663	1·52903	7·09915
3=	49·15853	·08495	2·29354	10·64873
4=	65·54470	·11326	3·05805	14·19831
5=	81·93088	·14158	3·82257	17·74788
6=	98·31706	·16989	4·58708	21·29746
7=	114·70323	·19821	5·35159	24·84704
8=	131·08941	·22652	6·11611	28·39661
9=	147·47558	·25484	6·88062	31·94619

IMPERIAL AND METRIC WEIGHTS AND MEASURES, EQUIVALENTS.

Measure of Capacity.

	Quarts to Litres.	Gallons to Litres.	Bushels to Dekalitres.	Quarters to Hectolitres.
1 —	1·13586	4·54346	3·63477	2·90781
2 —	2·27173	9·08692	7·26953	5·81563
3 —	3·40759	13·63037	10·90430	8·72344
4 —	4·54346	18·17383	14·53907	11·63125
5 —	5·67932	22·71729	18·17383	14·53907
6 —	6·81519	27·26075	21·80860	17·44688
7 —	7·95105	31·80421	25·44336	20·35469
8 —	9·08692	36·34766	29·07813	23·26250
9 —	10·22278	40·89112	32·71290	26·17032

Avoirdupois Weight.

	Grains to Milligrammes.	Ounces to Grammes.	Pounds to Kilo-grammes.	Hundred-weights to Quintals.	Tons to Milliers or Tonnes.
1 —	64·79895036	28·34954	·45359	·50802	1·01605
2 —	129·59790072	56·69908	·90719	1·01605	2·03210
3 —	194·39685109	85·04862	1·36078	1·52407	3·04814
4 —	259·19580145	113·39816	1·81437	2·03209	4·06419
5 —	323·99475181	141·74770	2·26796	2·54012	5·08024
6 —	388·79370218	170·09724	2·72156	3·04814	6·09629
7 —	453·59265255	198·44679	3·17515	3·55617	7·11233
8 —	518·39160291	226·79633	3·62874	4·06419	8·12838
9 —	583·19055327	255·14587	4·08233	4·57221	9·14443

	Troy Weight.		Apothecaries' Weight.
	Ounces to Grammes.	Pennyweights to Grammes.	Scruples to Grammes.
1 —	31·10350	1·55517	1·29598
2 —	62·20699	3·11035	2·59196
3 —	93·31059	4·66552	3·88794
4 —	124·41398	6·22070	5·18391
5 —	155·51748	7·77587	6·47989
6 —	186·62098	9·33105	7·77597
7 —	217·72447	10·88622	9·07185
8 —	248·82797	12·44140	10·36783
9 —	279·93147	13·99657	11·66381

METRIC AND IMPERIAL WEIGHTS AND MEASURES, EQUIVALENTS.

Linear Measure.

	Millimetres to Inches.	Metres to Feet.	Metres to Yards.	Kilometres to Miles.
1=	·03937079	3·28090	1·09363	·62138
2=	·07874158	6·56180	2·18727	1·24276
3=	·11811237	9·84270	3·28090	1·86415
4=	·15748316	13·12360	4·37453	2·48553
5=	·19685395	16·40450	5·46817	3·10691
6=	·23622474	19·68540	6·56180	3·72829
7=	·27559553	22·96629	7·65543	4·34968
8=	·31496632	26·24719	8·74906	4·97106
9=	·35433711	29·52809	9·84270	5·59244

Square Measure.

	Square Centimetres to Square Inches.	Square Metres to Square Feet.	Square Meters to Square Yards.	Hectares to Acres.
1=	·15501	10·76430	1·19603	2·47114
2=	·31001	21·52860	2·39207	4·94229
3=	·46502	32·29290	3·58810	7·41343
4=	·62002	43·05720	4·78413	9·88457
5=	·77503	53·82150	5·98017	12·35572
6=	·93004	64·58580	7·17620	14·82686
7=	1·08504	75·35010	8·37223	17·29800
8=	1·24005	86·11439	9·56827	19·76914
9=	1·39505	96·87869	10·76430	22·24029

Cubic Measure. / Apothecaries' Measure.

	Cubic Decimetres to Cubic Inches.	Cubic Metres to Cubic Feet.	Cubic Metres to Cubic Yards.	Cubic Centimeters to Fluid Drachms.
1=	61·02705	35·31658	1·30802	·28219
2=	122·05410	70·63316	2·61604	·56438
3=	183·08115	105·94974	3·92406	·84657
4=	244·10821	141·26632	5·23209	1·12877
5=	305·13526	176·58290	6·54011	1·41096
6=	366·16231	211·89948	7·84813	1·69315
7=	427·18936	247·21607	9·15615	1·97534
8=	488·21641	282·53265	10·46417	2·25753
9=	549·24346	317·84923	11·77219	2·53972

METRIC AND IMPERIAL WEIGHTS AND MEASURES, EQUIVALENTS.

Measure of Capacity.

	Litres to Pints.	Dekalitres to Gallons.	Hectolitres to Bushels.	Kilolitres to Quarters.
1=	1·76077	2·20097	2·75121	3·43901
2=	3·52154	4·40193	5·50242	6·87802
3=	5·28231	6·60290	8·25362	10·31703
4=	7·04308	8·80386	11·00483	13·75604
5=	8·80385	11·00483	13·75604	17·19505
6=	10·56462	13·20580	16·50725	20·63406
7=	12·32539	15·40676	19·25846	24·07307
8=	14·08616	17·60773	22·00966	27·51208
9=	15·84693	19·80870	24·76087	30·95110

Avoirdupois' Weight.

	Milligrammes to Grains.	Kilogrammes to Grains.	Kilogrammes to Pounds.	Quintals to Hundred-weights.	Milliers or Tonnes to Tons.
1=	·01543	15432·34874	2·20462	1·96841	·98421
2=	·03086	30864·69748	4·40924	3·93682	1·96841
3=	·04630	46297·04622	6·61386	5·90523	2·95262
4=	·06173	61729·39496	8·81849	7·87364	3·93682
5=	·07716	77161·74370	11·02311	9·84206	4·92103
6=	·09259	92594·09244	13·22773	11·81047	5·90524
7=	·10803	108026·44118	15·43235	13·77888	6·88944
8=	·12346	123458·78992	17·63697	15·74729	7·87365
9=	·13889	138891·13866	19·84159	17·71570	8·85785

Troy Weight. / Apothecaries' Weight.

	Troy Weight: Grammes to Ounces Troy.	Troy Weight: Grammes to Penny-weights.	Apothecaries' Weight: Grammes to Scruples.
1=	·03215	·64301	·77162
2=	·06430	1·28603	1·54323
3=	·09645	1·92904	2·31485
4=	·12860	2·57206	3·08647
5=	·16075	3·21507	3·85809
6=	·19290	3·85809	4·62970
7=	·22506	4·50110	5·40131
8=	·25721	5·14412	6·17294
9=	·28936	5·78713	6·94455

LEGAL STANDARD WIRE GAUGE AND METRIC EQUIVALENTS.

Numbers S.W.G.	Equivalents. Inch.	Equivalents. Millimetres.	Numbers S.W.G.	Equivalents. Inch.	Equivalents. Millimetres.
7/0	·500	12·700	23	·024	·610
6/0	·464	11·785	24	·022	·559
5/0	·432	10·973	25	·020	·508
4/0	·400	10·160	26	·018	·457
3/0	·372	9·449	27	·0164	·4166
2/0	·348	8·839	28	·0148	·3759
0	·324	8·229	29	·0136	·3454
1	·300	7·620	30	·0124	·3150
2	·276	7·010	31	·0116	·2946
3	·252	6·401	32	·0108	·2743
4	·232	5·893	33	·0100	·2540
5	·212	5·385	34	·0092	·2337
6	·192	4·877	35	·0084	·2134
7	·176	4·470	36	·0076	·1930
8	·160	4·064	37	·0068	·1727
9	·144	3·658	38	·0060	·1524
10	·128	3·251	39	·0052	·1321
11	·116	2·946	40	·0048	·1219
12	·104	2·642	41	·0044	·1118
13	·092	2·337	42	·0040	·1016
14	·080	2·032	43	·0036	·0914
15	·072	1·829	44	·0032	·0813
16	·064	1·626	45	·0028	·0711
17	·056	1·422	46	·0024	·0610
18	·048	1·219	47	·0020	·0508
19	·040	1·016	48	·0016	·0406
20	·036	·914	49	·0012	·0305
21	·032	·813	50	·0010	·0254
22	·028	·711	...	...	...

VOLUME OF WATER AT DIFFERENT TEMPERATURES.

For *ordinary* practical purposes, the following formulæ will enable the volume of water at different temperatures to be approximately ascertained; the formulæ give the increase of a given volume of fresh water, from the temperature of maximum density, viz., 39·2 degrees Fahrenheit, 4 degrees Centigrade, and 3·2 degrees Réaumur, if the given volume be multiplied by the formula appropriate, viz., either Fahrenheit, Centigrade, or Réaumur.

Let T = Temperature in all cases.

$$1+\frac{(T-39{\cdot}2)^2}{711(679+T)} \quad \text{for Fahrenheit scale.}$$

$$1+\frac{(T-4)^2}{395(395+T)} \quad \text{for Centigrade scale.}$$

$$1+\frac{(T-3{\cdot}2)^2}{316(316+T)} \quad \text{for Réaumur scale.}$$

If the volume is increased by difference of temperature, the weight of a given measure will be decreased.

When the volume is diminished, due to temperature, the weight of a given measure is increased.

The weight of a given measure is inversely as the volume at the different temperatures.

Temperatures.

The thermometers generally used are Fahrenheit, Centigrade, and Réaumur. The Fahrenheit scale is generally used in Great Britain.

32 degrees Fahrenheit is usually termed the freezing point, and 212 degrees Fahrenheit the boiling point of fresh water; 0 degrees Centigrade the freezing point, and 100 degrees Centigrade the boiling point; 0 degrees Réaumur the freezing point, and 80 degrees Réaumur the boiling point.

The boiling point at those temperatures is when the barometer is at 30 inches. The boiling point is *about* one and a half degrees Fahr. higher when the barometer stands at 31 inches, and *about* one and a half degrees Fahr. lower when the Barometer is at 29 inches, and *about* 208·7 degrees when the barometer is at 28 inches.

The equivalent degrees of temperature on Fahrenheit, Centigrade, and Réaumur scales may be found as follows :—

Let T_F = Temperature, Fahrenheit.

T_C = ,, Centigrade.

T_R = ,, Réaumur.

Then
$$\tfrac{5}{9}(T_F - 32) = T_C$$
$$\tfrac{4}{9}(T_F - 32) = T_R$$
$$\tfrac{9}{5}\,T_C + 32 = T_F$$
$$\tfrac{4}{5}\,T_C = T_R$$
$$\tfrac{9}{4}\,T_R + 32 = T_F$$
$$\tfrac{5}{4}\,T_R = T_C$$

Water, Pure and Sea.

Their Composition, Temperatures at which they boil, Specific Gravities, &c.

Composition of Pure Water.

Eight parts Hydrogen, and one of Oxygen by weight.

When the Barometer is at 30 inches.
Pure water, boiling point, 212 degrees Fahr.
Pure water, freezing point, 32 degrees Fahr.
Pure water, greatest density at 39·2 degrees Fahr.

Composition of Sea Water.

Sea water varies in its component parts, but the principal ingredients in mid-ocean water are about as follows, in 1000 parts by weight:—

Water, ...	962·0
Chloride of sodium, ...	27·1
Chloride of magnesium, ...	5·4
Sulphate of magnesia, ...	1·2
Sulphate of lime, ...	0·8
Chloride of potassium, ...	0·4
Chloride of lime, ...	0·1
Bromide of magnesia, ...	0·1
	997·1
Various ingredients, ...	2·9
	1000

The 2·9 parts consist of various ingredients and in different proportions, depending on a variety of circumstances, locality, &c., where the

...ter is obtained, such as sulphuretted hydrogen gas, hydrochloric ammonia, &c.

Sea water, greatest density at about [illegible] degrees Fahr.
Sea water, freezing point at about [illegible] degrees Fahr.
Sea water, saturated solution of brine,
Freezing point about [illegible] degrees Fahr.

Generally, for practical purposes, sea water may be considered to contain $\frac{1}{32}$ part of salt, and as the proportion of salt increases, the temperature necessary to raise it to the boiling point also increases. When the barometer is at [illegible] inches ordinarily, sea water boils at [illegible]3·2 degrees Fahr.

The following table shows the different boiling points of ordinary water according to the quantity of salt in the water, and the specific gravities as compared with pure water, which is considered as 1.

SEA WATER.

Boiling Point, Specific Gravities, &c.

Proportion of Salt in the Water.	Temperature Fahrenheit at which it boils.	Specific gravity.
$\frac{1}{32}$	213·2	1·029
$\frac{2}{32}$	214·4	1·058
$\frac{3}{32}$	215·5	1·087
$\frac{4}{32}$	216·7	1·116
$\frac{5}{32}$	217·9	1·145
$\frac{6}{32}$	219·1	1·174
$\frac{7}{32}$	220·3	1·203
$\frac{8}{32}$	221·5	1·232
$\frac{9}{32}$	222·7	1·261
$\frac{10}{32}$	223·8	1·290
$\frac{11}{32}$	225·0	1·319
$\frac{12}{32}$	226·1	1·348

When the water contains $\frac{12}{32}$ part of salt, and does not boil under a temperature of 226·1 degrees Fahr., it is then considered to be a saturated solution, as the water will not take any more salt in solution. [illegible] it has been stated that generally for practical purposes sea water may be considered to contain $\frac{1}{32}$ part of salt by weight, it is found to contain in places considerably more, and even nearly [illegible] a larger proportion has been found. It is therefore advisable [illegible] of the water in different parts of the ocean [illegible] not [illegible] arrived at by assuming that sea water is always of equal density [illegible] and that only $\frac{1}{32}$ part of salt is in it.

When sea water is used in boilers it is not advisable to let the proportion of salt in the water in the boiler exceed $\frac{3}{32}$ of the temperature at which it boils, or [illegible] degrees Fahr., when the barometer is at 30 inches. Keeping the water at such a density necessitates blowing off $\frac{1}{3}$ of the water put into the boiler. [illegible]

TABLE No. 204.

WEIGHT AND SPECIFIC GRAVITY OF METALS.

	Specific Gravity.	1 Cubic Foot.	1 Cubic Inch.	1 Square Foot 1 Inch Thick.	1 Square Foot $\frac{1}{8}$ Inch Thick.	1 Square Foot $\frac{1}{16}$ Inch Thick.	1 Square Foot $\frac{1}{32}$ Inch Thick.	1 Square Foot $\frac{1}{64}$ Inch Thick.	1 Square Foot $\frac{1}{100}$ Inch Thick.	Cubic Ins. to One Pound.
		lbs.	lb.	lbs.	lbs.	lbs.	lbs.	lb.	lb.	Cubic ins.
Mercury, . . .	13·560	845	·4890	70·416	8·802	4·401	2·200	1·100	·704	2·044
Lead, ...	11·392	710	·4108	59·166	7·395	3·697	1·848	·924	·591	2·433
Copper, *sheet*, . .	8·825	550	·3182	45·833	5·729	2·864	1·432	·716	·458	3·141
,, *cast*, . .	8·665	540	·3125	45·000	5·625	2·812	1·406	·703	·450	3·200
Brass, *sheet*, . .	8·504	530	·3067	44·166	5·520	2·760	1·380	·690	·441	3·260
,, *cast*, . .	8·023	500	·2893	41·666	5·208	2·604	1·302	·651	·416	3·456
Steel, *soft or mild*, .	7·862	490	·2835	40·833	5·104	2·552	1·276	·638	·408	3·526
,, *hard*, . .	7·814	487	·2818	40·583	5·072	2·536	1·268	·634	·405	3·548
Iron, *wrought*, . .	7·702	480	.2777	40·000	5·000	2·500	1·250	·625	·400	3·600
,, *cast*, . .	7·124	444	·2569	37·000	4·625	2·312	1·156	·578	·370	3·891
Tin, *cast*, . .	7·301	455	·2633	37·916	4·739	2·369	1·184	·592	·379	3·797
Zinc, *cast*, . .	6·900	430	·2488	35·833	4·479	2·239	1·119	·559	·358	4·018

The cross sectional area in square inches of a bar or angle, &c., multiplied by the length in inches of the bar or angle, &c., equals the number of cubic inches which it contains; therefore, the number of cubic inches in an article, multiplied by the weight of one cubic inch of the material of which the article is composed, equals the weight in lbs.

SAFETY VALVES.

There should be at least two safety valves fitted to each boiler, the combined area of which should not be less than that found by the table further on, but the smallest size which should be used is 2 inches in diameter.

Safety valves should always be fitted with screw lifting gear, and arranged so that two or more valves on any one boiler can at all times be eased together, without interfering with the valves on any other boiler. The lifting-gear should in all cases be arranged so that it can be worked by hand from the engine room or stoke hole, and it should be capable of lifting the valves when steam is *not* up. Unless the lift and means for escape of the waste steam be sufficient, the effect is the same as reducing the area of the valve, or extra loading it.

All safety valves should have a lift equal at least to one-fourth their diameter.

The openings for the passage of steam to and from the valves, including the waste steam pipe, should have an area not less than the area of the valve as found by the table further on.

Each safety valve box should have a drain pipe fitted at its lowest part.

When spring safety valves are fitted, the springs and valves should always be so arranged that the valve cannot come out, if the spring should break.

Safety valves should be cased in, so that the boiler attendant cannot in any way increase the load on the valves.

The springs for safety valves should, as far as practicable, be protected from the steam and impurities issuing from the boiler.

When safety valves are loaded by direct springs, the compressing screws should abut against metal stops or washers, when the loads settled and approved of by the Engineer Inspector are on the valves.

When valves are loaded by dead-weights, care should be taken that they are so fitted that they will not prevent the free escape of the steam.

Safety valves and their seats should be made of brass, and the seats should be secured by brass studs and brass nuts; the minimum number of the studs and nuts should be three.

The weight necessary to load an ordinary dead-weighted safety valve may be found by multiplying the area of the valve by the working pressure per square inch, and subtracting the weight of the valve and spindle.

Each weight should represent a given number of lbs. pressure, say 5 lbs., as it is undesirable to have any one weight very heavy or cumbersome; the weights should have the corners rounded, the holes in the centre of the weights should be easy fits for the spindle, and the edges of the holes should also be rounded off; the skin of the casting should *not* be broken; the weight of each, and also its equi-

valent in lbs. pressure per square inch, should be stamped on it. Means should be provided for lifting each weight separately.

If the safety valve lever be not bushed with brass, the pins should be of brass; iron and iron working together should not be approved of.

The weight required to be placed on the end of the safety valve lever, so that there may be a given working pressure per square inch on the valve, may be found by multiplying the area of the valve by the working pressure, and subtracting from the product the effective weight of the lever and valve, and dividing the remainder by the leverage, which is the total length of lever from the fulcrum to the point where the weight is suspended, divided by the distance from the centre of the valve to the fulcrum in a line parallel to the face of the valve.

If the area of the valve be 10 square inches, and the working pressure 40 lbs. per square inch, the effective weight of lever and valve 20 lbs., the total length of lever 30 inches, and the distance between the centre of the valve and the fulcrum 3 inches, the weight on the end of the lever is 38 lbs.,

$$(10 \times 40) - 20 = 380$$
$$30 \div 3 = 10$$
$$380 \div 10 = 38 \text{ lbs.},$$

which is the weight required to be placed on the end of the lever to load the valve to 40 lbs. per square inch.

When the weight of the valve is 2 lbs., the weight of the lever 4 lbs., the distance between the fulcrum and the centre of gravity of the lever 13·5 inches, and the distance between the fulcrum and centre of valve 3 inches, the effective weight of the lever and valve is 20 lbs.,

$$13{\cdot}5 \div 3 = 4{\cdot}5$$
$$(4{\cdot}5 \times 4) + 2 = 20 \text{ lbs.},$$

which is the effective weight of lever and valve. Therefore, if the distance between the fulcrum and centre of gravity of lever be divided by the distance between the fulcrum and centre of valve, and then multiplied by the weight of lever, and the weight of the valve added to the product, the effective weight of lever and valve is found.

In any case in which a spring balance is used to load a lever safety valve, the leverage should be equal to the number of square inches area of the valve; that is, if the area of the valve be 10 square inches, the leverage should be 10, or the total length of lever should be 10 times the distance between the centre of valve and fulcrum. When the leverage and balance are not so arranged, errors frequently take place, and have caused explosions.

TESTING AND ADJUSTING SAFETY VALVES, &c.

All safety valves should be tested for accumulation, when under ful steam and hard firing, for at least twenty minutes, with the feeds shut off and stop valves closed; the accumulation of pressure should not exceed 10 per cent. of the loaded pressure. It should not be overlooked that, with the nominal factor of 5, the factor is reduced to *about* 4·5 when the accumulation is 10 per cent.

If safety valves, particularly spring and lever valves, be not properly tried, to see that there is no undue amount of accumulation of pressure, accidents will surely follow. Valves should be particularly well fitted, but should not be too tight, otherwise when steam is up, more particularly after the water has been priming, the valves are very apt to stick, and an undue accumulation of pressure takes place.

When the Engineer Inspector has settled the working pressure, he should see the valves loaded to that pressure, and the weights or springs fixed in such a manner as to prevent the possibility of their shifting, so as to, in any way, increase the load on the safety valves.

Although different methods of loading safety valves have been remarked on, direct spring loaded valves, when properly constructed, are those which are recommended for marine boilers; if land boilers were always in charge of skilled men, spring loaded valves might also be recommended for them. Very many land boilers are looked after by men who should not be trusted to adjust spring safety valves. Valves loaded by direct weights are those which are most likely to act as real safety valves, when in the hands of the ordinary attendants of land boilers. Although it may not in every case be necessary to have all the valves on such boilers loaded by direct weights, it is desirable that one of them be so fitted, and the others, in some cases if desired, may be loaded by lever and weights, but spring lever loaded valves alone are very undesirable; such a method presents a ready way of overloading, and many explosions of boilers have taken place, due to the extra loading of lever valves. If the load be applied by a spring balance, there should be a stop on the screw to prevent the pressure being increased by merely turning the nut; but, even then, the pressure can be easily increased by reckless or ignorant persons, and even accidentally this has occurred; therefore, it is very undesirable that lever valves should be the only description fitted on any boiler, more particularly if not properly cased in. So far as the valve is concerned, the common flat face or mitre seat keeps longer in order than a lip or lifter one, and gives much less trouble when steam is blowing off freely.

The areas of safety valves as found by the table which follows, No. 205, are minimum areas, and it is desirable that they should be exceeded, for, if not, when the pressure is reduced, due to the

the boiler, &c., the accumulation will exceed that which it is prudent to allow.

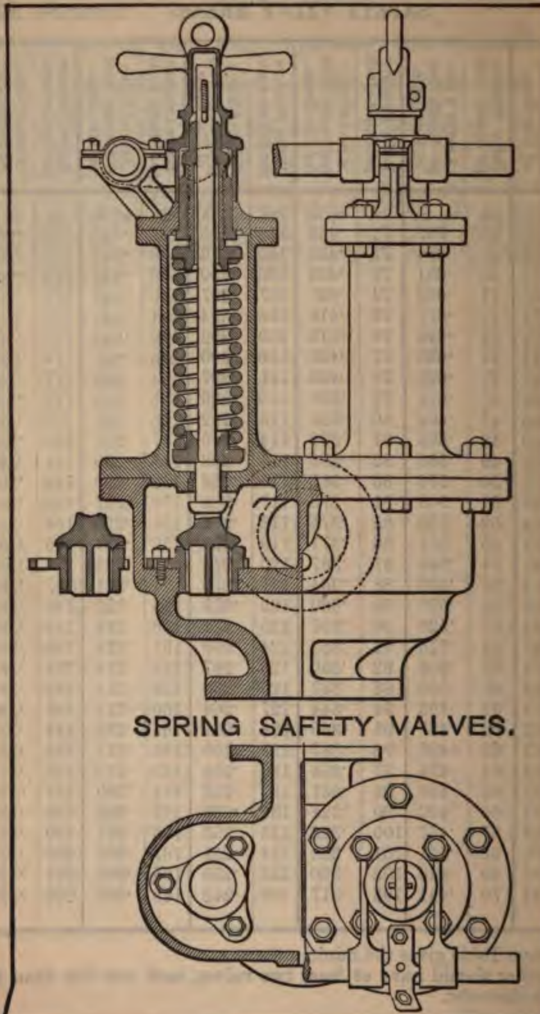
When forced draught is used, it is essential that the areas of safety valves should be considerably in excess of those arrived at by the use of the table, otherwise the accumulation will be too great. The amount of increase will depend upon the circumstances of each case; but in no case is less than 25 per cent. increase recommended, and it has been found that, even when the area was double that required by the table, there was more accumulation than was desirable. It is expedient to arrange so that the forced draught can be stopped from the starting platform, more particularly when the draught does not cease when the engine stops.

Boiler Pressure per Square Inch.	Area of Valve per Square Foot of Fire Grate.	Boiler Pressure per Square Inch.	Area of Valve per Square Foot of Fire Grate.	Boiler Pressure per Square Inch.	Area of Valve per Square Foot of Fire Grate.	Boiler Pressure per Square Inch.	Area of Valve per Square Foot of Fire Grate.	Boiler Pressure per Square Inch.	Area of Valve per Square Foot of Fire Grate.	Boiler Pressure per Square Inch.	Area of Valve per Square Foot of Fire Grate.
lbs.	sq. ins.	lbs.	sq. in.	lbs.	sq. in.	lbs.	sq. in.	lbs.	sq. in.	lbs.	sq. in.
5	2·206	38	·707	71	·436	104	·315	137	·246	170	·202
6	1·935	39	·694	72	·431	105	·312	138	·245	171	·201
7	1·768	40	·681	73	·426	106	·309	139	·243	172	·200
8	1·655	41	·669	74	·421	107	·307	140	·241	173	·199
9	1·571	42	·657	75	·416	108	·304	141	·240	174	·198
10	1·502	43	·646	76	·412	109	·302	142	·238	175	·197
11	1·442	44	·635	77	·407	110	·300	143	·237	176	·196
12	1·388	45	·625	78	·403	111	·297	144	·235	177	·195
13	1·339	46	·614	79	·398	112	·295	145	·234	178	·194
14	1·293	47	·604	80	·394	113	·292	146	·232	179	·193
15	1·250	48	·595	81	·390	114	·290	147	·231	180	·192
16	1·209	49	·585	82	·386	115	·288	148	·230	181	·191
17	1·171	50	·576	83	·382	116	·286	149	·228	182	·190
18	1·136	51	·568	84	·378	117	·284	150	·227	183	·189
19	1·102	52	·559	85	·375	118	·281	151	·225	184	·188
20	1·071	53	·551	86	·371	119	·279	152	·224	185	·187
21	1·041	54	·543	87	·367	120	·277	153	·223	186	·186
22	1·013	55	·535	88	·364	121	·275	154	·221	187	·185
23	·986	56	·528	89	·360	122	·273	155	220	188	·184
24	·961	57	·520	90	·357	123	·271	156	·219	189	·183
25	·937	58	·513	91	·353	124	·269	157	·218	190	·182
26	·914	59	·506	92	·350	125	·267	158	·216	191	·181
27	·892	60	·500	93	·347	126	·265	159	·215	192	·181
28	·872	61	·493	94	·344	127	·264	160	·214	193	·180
29	·852	62	·487	95	·340	128	·262	161	·213	194	·179
30	·833	63	·480	96	·337	129	·260	162	·211	195	·178
31	·815	64	·474	97	·334	130	·258	163	·210	196	·177
32	·797	65	·468	98	·331	131	·256	164	·209	197	·176
33	·781	66	·462	99	·328	132	·255	165	·208	198	·176
34	·765	67	·457	100	·326	133	·253	166	·207	199	·175
35	·750	68	·451	101	·323	134	·251	167	·206	200	·174
36	·735	69	·446	102	·320	135	·250	168	·204	201	·173
37	·721	70	·441	103	·317	136	·248	169	·203	202	·172

The above Table gives the minimum areas.

Each boiler should have at least two valves, each not less than 2 inches in diameter.

20


SPRING SAFETY VALVES.

SPRING SAFETY VALVES.

In the Tables Nos. [illegible] and [illegible] which follow these notes, the dimensions of the different parts of safety valves loaded by spiral springs will be found.

The valves, seats, spindles, compressing screws and their nuts, spring washers, bushes in bottom of spring case, washers in top of spindle and cap, studs and nuts for securing the seats, and the bushes or bearings for easing gear shaft, should be made of a good quality of brass or gun metal.

The chests, spring cases, and caps may be made of cast iron.

The easing gear shaft should be made of wrought iron or steel; wrought iron shafts are recommended, with the lifting forks forged out of the solid.

The bolts or studs for the flanges and easing gear should be made of wrought iron.

The top of hoods may be made either as shown in full lines in the drawing, or with cross handles, as shown by the dotted lines.

The valve is shown without a lip, and also, at the side, with a lip, but a valve without a lip is recommended, as its action is much less violent.

There should not be a less number of ribs to the neck of the valve chests than four, as shown in the drawing, but it may be desirable to have more than four in the large sizes.

In the drawing, springs made of round steel are shown, but in the tables the sizes of springs both of round and square steel, are given.

SPRING SAFETY VALVES.

TABLE No. 206.

Diameter of Valves.	Diameter of Inlet.	Diameter of Outlet.	Dimensions of Chest below Valves, inside.			Dimensions of Chest above Valves, inside.		Height of Chest.	Diameter of Bottom Flange of Chest.
			Height.	Length.	Width.	Length.	Width.	Total.	
inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.
2	2 7/8	3	4 1/2	11	3	13 1/4	5 1/4	9 3/8	8 1/2
2 1/4	3 3/16	3 5/16	4 3/4	11 13/16	3 5/16	14 3/16	5 11/16	10	9
2 1/2	3 9/16	3 11/16	5	12 5/8	3 5/8	15 1/8	6 1/8	10 11/16	9 1/2
2 3/4	3 15/16	4 1/16	5 1/4	13 7/16	3 15/16	16 1/16	6 9/16	11 5/16	10
3	4 1/4	4 7/16	5 1/2	14 1/4	4 1/4	17	7	12 1/16	10 1/2
3 1/4	4 5/8	4 13/16	5 3/4	15 1/16	4 9/16	17 15/16	7 7/16	12 11/16	11
3 1/2	5	5 3/16	6	15 7/8	4 7/8	18 7/8	7 7/8	13 3/8	11 1/2
3 3/4	5 5/16	5 1/2	6 1/4	16 11/16	5 3/16	19 13/16	8 5/16	14	12
4	5 11/16	5 15/16	6 1/2	17 1/2	5 1/2	20 3/4	8 3/4	14 11/16	12 1/2
4 1/4	6	6 1/4	6 3/4	18 5/16	5 13/16	21 11/16	9 3/16	15 1/4	13
4 1/2	6 3/8	6 5/8	7	19 1/8	6 1/8	22 5/8	9 5/8	16	13 1/2
4 3/4	6 3/4	7	7 1/4	19 15/16	6 7/16	23 9/16	10 1/16	16 5/8	14
5	7 1/16	7 3/8	7 1/2	20 3/4	6 3/4	24 1/2	10 1/2	17 5/16	14 1/2
5 1/4	7 7/16	7 3/4	7 3/4	21 9/16	7 1/16	25 7/16	10 15/16	18	15
5 1/2	7 3/4	8 1/16	8	22 3/8	7 3/8	26 3/8	11 3/8	18 5/8	15 1/2
5 3/4	8 1/8	8 7/16	8 1/4	23 3/16	7 11/16	27 5/16	11 13/16	19 1/4	16
6	8 1/2	8 7/8	8 1/2	24	8	28 1/4	12 1/4	20	16 1/2

SPRING SAFETY VALVES.

Table No. 207.

Diameter of Valves.	Top Flange of Valve Chest.		Bolts for Bottom Flange of Chest.		Brass Studs for securing Valve Seats.		Drain Pipe, Diameter.	Spring Case.	
	Thickness.	Diameter.	Number.	Diameter.	Number.	Diameter.		Height, Total.	Bottom Flange, Diameter.
inches.	inch.	inches.		inch.		inch.	inch.	inches.	inches.
2	13/16	9	6	⅝	3	½	¾	8 ½	9
2¼	⅞	9½	6	⅝	3	½	¾	9 [illegible]	9½
2½	⅞	10	6	⅝	3	½	¾	10 ⅛	10
2¾	⅞	10½	6	⅝	3	½	¾	11 [illegible]	10½
3	15/16	11	6	¾	3	½	¾	[illegible]	11
3¼	15/16	11½	6	¾	3	⅝	¾	[illegible]	[illegible]
3½	15/16	12	6	¾	3	⅝	¾	[illegible]	[illegible]
3¾	1	12½	6	¾	3	⅝	¾	[illegible]	[illegible]
4	1	13	8	¾	4	⅝	[illegible]	[illegible]	[illegible]
4¼	1	13½	8	¾	4	⅝	[illegible]	[illegible]	[illegible]
4½	1 1/16	14	8	¾	4	⅝	[illegible]	[illegible]	[illegible]
4¾	1 1/16	14½	8	¾	4	⅝	[illegible]	[illegible]	[illegible]
5	1 1/16	15	8	⅞	4	¾	[illegible]	[illegible]	[illegible]
5¼	1 ⅛	15½	8	⅞	4	¾	[illegible]	[illegible]	[illegible]
5½	1 ⅛	16	8	⅞	4	¾	[illegible]	[illegible]	[illegible]
5¾	1 ⅛	16½	8	⅞	4	¾	[illegible]	[illegible]	[illegible]
6	1 ⅛	17	8	⅞	4	¾	[illegible]	[illegible]	[illegible]

SPRING SAFETY VALVES.

TABLE No. 208.

Diameter of Valves.	Bolts and Studs connecting Spring Case to Valve Chest.		Bolts connecting Cap to Spring Case.		Length of Lifting Lever.	Length of Guide of Hood.	Lift of Valve and Clearance at Top of Spindle.	Distance between Centres of Valves.
	Number.	Diameter.	Number.	Diameter.				
inches.		inch.		inch.	inches.	inches.	inch.	inches.
2	6	1/2	4	1/2	3 1/2	1	1/2	8
2 1/4	6	1/2	4	1/2	3 9/16	1 1/16	9/16	8 1/2
2 1/2	6	1/2	4	1/2	3 5/8	1 1/8	5/8	9
2 3/4	6	1/2	4	1/2	3 11/16	1 3/16	11/16	9 1/2
3	6	1/2	4	1/2	3 3/4	1 1/4	3/4	10
3 1/4	6	1/2	4	1/2	3 13/16	1 5/16	13/16	10 1/2
3 1/2	6	1/2	4	1/2	3 7/8	1 3/8	7/8	11
3 3/4	6	5/8	4	5/8	3 15/16	1 7/16	15/16	11 1/2
4	6	5/8	4	5/8	4	1 1/2	1	12
4 1/4	6	5/8	4	5/8	4 1/16	1 9/16	1 1/16	12 1/2
4 1/2	6	5/8	4	5/8	4 1/8	1 5/8	1 1/8	13
4 3/4	6	5/8	4	5/8	4 3/16	1 11/16	1 3/16	13 1/2
5	6	3/4	4	3/4	4 1/4	1 3/4	1 1/4	14
5 1/4	6	3/4	4	3/4	4 5/16	1 13/16	1 5/16	14 1/2
5 1/2	6	3/4	4	3/4	4 3/8	1 7/8	1 3/8	15
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15 1/2

SPRING SAFETY VALVES.

TABLE No. 269.

Diameter of Spindles.		Dimensions of Cotters.		Compressing Screw.		
Body.	Lower Part.	Breadth.	Thickness.	Diameter.	Length under Head.	Depth of Nut.
Inch.	Inches.	Inches.	Inch.	Inches.	Inches.	Inches.
3/4	7/8	15/16	5/16	1 1/4	2 9/16	1 9/16
13/16	15/16	1	7/32	1 1/4	2 5/8	1 5/8
7/8	1 1/16	1 1/16	7/32	1 3/8	2 11/16	1 11/16
15/16	1 1/8	1 1/8	1/4	1 1/2	2 3/4	1 3/4
1	1 1/4	1 1/4	1/4	1 5/8	2 13/16	1 13/16
1 1/16	1 5/16	1 3/8	1/4	1 3/4	2 7/8	1 7/8
1 1/8	1 7/16	1 3/8	9/32	1 3/4	2 15/16	1 15/16
1 3/16	1 9/16	1 1/2	9/32	1 7/8	3	2
1 1/4	1 5/8	1 9/16	5/16	2	3 1/16	2 1/16
1 5/16	1 3/4	1 5/8	5/16	2 1/8	3 1/8	2 1/8
1 3/8	1 13/16	1 3/4	11/32	2 1/8	3 3/16	2 3/16
1 7/16	1 7/8	1 3/4	3/8	2 1/4	3 1/4	2 1/4
1 1/2	2	1 7/8	3/8	2 3/8	3 5/16	2 5/16
1 9/16	2 1/16	2	3/8	2 3/8	3 3/8	2 3/8
1 5/8	2 1/8	2	13/32	2 1/2	3 7/16	2 7/16
1 11/16	2 1/4	2 1/8	13/32	2 5/8	3 1/2	2 1/2
1 3/4	2 3/8	2 3/8	7/16	2 3/4	3 9/16	2 9/16

SPRING SAFETY VALVES.

Springs.		Working Load for Springs.		Spring Case.				Washers for Springs, Thickness of Flanges.
Diameter or Side of Steel.	Mean Diameter of Coils.	Round Steel.	Square Steel.	Diameter Inside.	Thickness of Case.	Diameter of Top Flange.	Thickness of Top Flange.	
inch.	inches.	lbs.	lbs.	inches.	inch.	inches.	inch.	inch.
1/4	1 1/4	100	137	2	1/4	5 1/4	7/16	1/4
9/32	1 13/32	126	174	2 1/4	1/4	5 1/2	9/16	9/32
5/16	1 9/16	156	214	2 7/16	5/16	5 3/4	5/8	5/16
11/32	1 23/32	189	260	2 5/8	5/16	6	5/8	11/32
3/8	1 7/8	225	309	2 13/16	5/16	6 1/4	5/8	3/8
13/32	2 1/32	264	363	3 1/16	5/16	6 1/2	5/8	13/32
7/16	2 3/16	306	421	3 1/4	3/8	6 3/4	11/16	7/16
15/32	2 11/32	351	483	3 7/16	3/8	7	11/16	15/32
1/2	2 1/2	400	550	3 5/8	3/8	7 1/4	11/16	1/2
17/32	2 21/32	451	620	3 7/8	3/8	7 1/2	11/16	17/32
9/16	2 13/16	506	696	4 1/16	3/8	7 3/4	11/16	9/16
19/32	2 31/32	564	775	4 1/4	7/16	8	3/4	19/32
5/8	3 1/8	625	859	4 7/16	7/16	8 1/4	3/4	5/8
21/32	3 9/32	689	947	4 11/16	7/16	8 1/2	3/4	21/32
11/16	3 7/16	756	1039	4 7/8	7/16	8 3/4	3/4	11/16
23/32	3 19/32	826	1136	5 1/16	7/16	9	3/4	23/32
3/4	3 3/4	900	1237	5 1/4	7/16	9 1/4	3/4	3/4
25/32	3 29/32	976	1342	5 1/2	1/2	9 1/2	13/16	25/32
13/16	4 1/16	1056	1452	5 11/16	1/2	9 3/4	13/16	13/16
27/32	4 7/32	1139	1566	5 7/8	1/2	10	13/16	27/32
7/8	4 3/8	1225	1684	6 1/16	1/2	10 1/4	13/16	7/8
29/32	4 17/32	1314	1806	6 5/16	1/2	10 1/2	13/16	29/32
15/16	4 11/16	1406	1933	6 1/2	1/2	10 3/4	13/16	15/16
31/32	4 27/32	1501	2064	6 11/16	1/2	11	13/16	31/32
1	5	1600	2200	6 7/8	9/16	11 1/4	7/8	1
1 1/32	5 5/32	1701	2339	7 1/8	9/16	11 1/2	7/8	1 1/32
1 1/16	5 5/16	1806	2483	7 5/16	9/16	11 3/4	7/8	1 1/16
1 3/32	5 15/32	1914	2631	7 1/2	9/16	12	7/8	1 3/32
1 1/8	5 5/8	2025	2784	7 11/16	9/16	12 1/4	7/8	1 1/8
1 5/32	5 25/32	2139	2941	7 15/16	9/16	12 1/2	7/8	1 5/32
1 3/16	5 15/16	2256	3102	8 1/8	9/16	12 3/4	7/8	1 3/16
1 7/32	6 3/32	2376	3267	8 5/16	5/8	13	15/16	1 7/32
1 1/4	6 1/4	2500	3437	8 1/2	5/8	13 1/4	15/16	1 1/4

SPRING SAFETY VALVES.

Table No. 211.

The Dimensions in this Table are for Valves loaded to a Pressure not exceeding 40 Pounds per Square Inch.

Diameter of Valves.	Diameter of Body of Spindle.	Bottom Flange of Chest Thickness.	Flange on Chest for Waste Steam Pipe.		Thickness of Chest.		Easing Gear Shaft, Diameter.
			Diameter.	Thickness.	Below Valves.	Above Valves.	
inches.	inch.	inch.	inches.	inch.	inch.	inch.	inch.
2	$\frac{3}{4}$	$\frac{3}{4}$	$7\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{7}{8}$
$2\frac{1}{4}$	$\frac{13}{16}$	$\frac{13}{16}$	$7\frac{15}{16}$	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{3}{8}$	$\frac{7}{8}$
$2\frac{1}{2}$	$\frac{7}{8}$	$\frac{13}{16}$	$8\frac{3}{8}$	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{3}{8}$	$\frac{15}{16}$
$2\frac{3}{4}$	$\frac{15}{16}$	$\frac{13}{16}$	$8\frac{13}{16}$	$\frac{5}{8}$	$\frac{9}{16}$	$\frac{7}{16}$	1
3	1	$\frac{13}{16}$	$9\frac{1}{4}$	$\frac{5}{8}$	$\frac{9}{16}$	$\frac{7}{16}$	$1\frac{1}{16}$
$3\frac{1}{4}$	$1\frac{1}{16}$	$\frac{7}{8}$	$9\frac{11}{16}$	$\frac{11}{16}$	$\frac{5}{8}$	$\frac{7}{16}$	$1\frac{1}{8}$
$3\frac{1}{2}$	$1\frac{1}{8}$	$\frac{7}{8}$	$10\frac{1}{8}$	$\frac{11}{16}$	$\frac{5}{8}$	$\frac{7}{16}$	$1\frac{3}{16}$
$3\frac{3}{4}$	$1\frac{3}{16}$	$\frac{7}{8}$	$10\frac{9}{16}$	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{7}{16}$	$1\frac{1}{4}$
4	$1\frac{1}{4}$	$\frac{7}{8}$	11	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{7}{16}$	$1\frac{5}{16}$
$4\frac{1}{4}$	$1\frac{5}{16}$	$\frac{15}{16}$	$11\frac{7}{16}$	$\frac{13}{16}$	$\frac{11}{16}$	$\frac{7}{16}$	$1\frac{3}{8}$
$4\frac{1}{2}$	$1\frac{3}{8}$	$\frac{15}{16}$	$11\frac{7}{8}$	$\frac{13}{16}$	$\frac{11}{16}$	$\frac{7}{16}$	$1\frac{7}{16}$
$4\frac{3}{4}$	$1\frac{7}{16}$	$\frac{15}{16}$	$12\frac{5}{16}$	$\frac{7}{8}$	$\frac{11}{16}$	$\frac{1}{2}$	$1\frac{1}{2}$
5	$1\frac{1}{2}$	$\frac{15}{16}$	$12\frac{3}{4}$	$\frac{7}{8}$	$\frac{11}{16}$	$\frac{1}{2}$	$1\frac{9}{16}$
$5\frac{1}{4}$	$1\frac{9}{16}$	1	$13\frac{3}{16}$	$\frac{15}{16}$	$\frac{3}{4}$	$\frac{1}{2}$	$1\frac{5}{8}$
$5\frac{1}{2}$	$1\frac{5}{8}$	1	$13\frac{5}{8}$	$\frac{15}{16}$	$\frac{3}{4}$	$\frac{1}{2}$	$1\frac{11}{16}$
$5\frac{3}{4}$	$1\frac{11}{16}$	1	$14\frac{1}{16}$	1	$\frac{3}{4}$	$\frac{1}{2}$	$1\frac{3}{4}$
6	$1\frac{3}{4}$	1	$14\frac{1}{2}$	1	$\frac{3}{4}$	$\frac{1}{2}$	$1\frac{13}{16}$

SPRING SAFETY VALVES.

TABLE No. 212.

The Dimensions in this Table are for Valves loaded to a Pressure not exceeding 80 Pounds per Square Inch.

Diameter of Valves.	Diameter of Body of Spindles.	Bottom Flange of Chest, Thickness.	Thickness of Chest.		Easing Gear Shaft, Diameter.
			Below Valves.	Above Valves.	
inches.	inch.	inch.	inch.	inch.	inches.
2	13/16	13/16	9/16	7/16	1
2 1/4	7/8	7/8	5/8	7/16	1 1/16
2 1/2	15/16	7/8	5/8	7/16	1 3/16
2 3/4	1	7/8	5/8	7/16	1 1/4
3	1 1/16	15/16	11/16	7/16	1 3/8
3 1/4	1 1/8	15/16	11/16	1/2	1 7/16
3 1/2	1 3/16	15/16	11/16	1/2	1 1/2
3 3/4	1 1/4	1	3/4	1/2	1 9/16
4	1 5/16	1	3/4	1/2	1 11/16
4 1/4	1 3/8	1	3/4	1/2	1 3/4
4 1/2	1 7/16	1 1/16	13/16	1/2	1 13/16
4 3/4	1 1/2	1 1/16	13/16	9/16	1 7/8
5	1 9/16	1 1/16	13/16	9/16	1 15/16
5 1/4	1 5/8	1 1/8	7/8	9/16	2 1/16
5 1/2	1 11/16	1 1/8	7/8	9/16	2 1/8
5 3/4	1 3/4	1 1/8	7/8	9/16	2 3/16

SPRING SAFETY VALVES. TABLE No. 213.

The Dimensions in this Table are for Valves loaded to a Pressure not exceeding 120 Pounds per Square Inch.

Diameter of Valves.	Diameter of Body of Spindles.	Bottom Flange of Chest, Thickness.	Thickness of Chest.		Easing Gear Shaft, Diameter.
			Below Valves.	Above Valves.	
inches.	inch.	inch.	inch.	inch.	inches.
2	7/8	7/8	5/8	7/16	1 3/16
2 1/4	15/16	15/16	11/16	7/16	1 1/4
2 1/2	1	15/16	11/16	1/2	1 3/8
2 3/4	1 1/16	1	3/4	1/2	1 7/16
3	1 1/8	1	3/4	1/2	1 9/16
3 1/4	1 3/16	1	3/4	1/2	1 5/8
3 1/2	1 1/4	1 1/16	13/16	1/2	1 3/4
3 3/4	1 5/16	1 1/16	13/16	9/16	1 13/16
4	1 3/8	1 1/16	13/16	9/16	1 7/8
4 1/4	1 7/16	1 1/8	7/8	9/16	2
4 1/2	1 1/2	1 1/8	7/8	9/16	2 1/16
4 3/4	1 9/16	1 3/16	15/16	9/16	2 3/16
5	1 5/8	1 3/16	15/16	5/8	2 1/4
5 1/4	1 11/16	1 3/16	15/16	5/8	2 5/16
5 1/2	1 3/4	1 1/4	1	5/8	2 3/8

SPRING SAFETY VALVES.

TABLE No. 214.

The Dimensions in this Table are for Valves loaded to a Pressure not exceeding 160 Pounds per Square Inch.

Diameter of Valves.	Diameter of Body of Spindles.	Bottom Flange of Chest, Thickness.	Thickness of Chest.		Easing Gear Shaft, Diameter.
			Below Valves.	Above Valves.	
inches.	inch.	inch.	inch.	inch.	inches.
2	15/16	15/16	11/16	1/2	1 1/4
2 1/4	1	1	3/4	1/2	1 3/8
2 1/2	1 1/16	1	3/4	1/2	1 1/2
2 3/4	1 1/8	1 1/16	13/16	1/2	1 9/16
3	1 3/16	1 1/16	13/16	9/16	1 11/16
3 1/4	1 1/4	1 1/8	7/8	9/16	1 13/16
3 1/2	1 5/16	1 1/8	7/8	9/16	1 7/8
3 3/4	1 3/8	1 3/16	15/16	9/16	2
4	1 7/16	1 3/16	15/16	5/8	2 1/16
4 1/4	1 1/2	1 3/16	15/16	5/8	2 3/16
4 1/2	1 9/16	1 1/4	1	5/8	2 5/16
4 3/4	1 5/8	1 1/4	1	5/8	2 3/8
5	1 11/16	1 5/16	1 1/16	5/8	2 1/2
5 1/4	1 3/4	1 5/16	1 1/16	11/16	2 9/16

SPRING SAFETY VALVES.

Table No. 215.

The Dimensions in this Table are for Valves loaded to a Pressure not exceeding 200 Pounds per Square Inch.

Diameter of Valves.	Diameter of Body of Spindles.	Bottom Flange of Chest, Thickness.	Thickness of Chest.		Easing Gear Shaft, Diameter.
			Below Valves.	Above Valves.	
inches.	inch.	inch.	inch.	inch.	inches.
2	1	1	[illegible]	[illegible]	1 ⅜
2¼	1 1/16	[illegible]	[illegible]	[illegible]	1 ½
2½	1 ⅛	[illegible]	[illegible]	[illegible]	1 ⅝
2¾	1 3/16	[illegible]	[illegible]	[illegible]	1 11/16
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SPIRAL SPRINGS FOR SAFETY VALVES.

D = Diameter from centre to centre of wire, in inches, which is usually termed the mean diameter of the spring (without load).
d = Diameter of wire or side of square, in inches.
S = Load on spring, in lbs.
C = 11000, if spring is made of square steel
C = 8000, if spring is made of round steel.
K = Compression, in inches.
N = Number of coils in spring.

$$\sqrt[3]{\frac{S \times D}{C}} = d,$$

$$\frac{d^3 \times C}{S} = D.$$

$$\frac{C \times d^3}{D} = S.$$

If the ratio $\frac{D}{d}$ be constant, the safe working load varies as the square of the side, or diameter, of the steel of which springs are made; but when D is constant—that is, the same for all sizes of steel—the safe working load varies as the cube of the side, or diameter, of the steel. If r is the ratio which is considered desirable, then :—

$$r \times d = D.$$

$$\frac{S \times r \times d}{C} = d^3.$$

$$\sqrt{\frac{S \times r}{C}} = d.$$

A convenient value for the ratio r is 5, and the loads given in Table No. 210 are for springs of this ratio. This makes a well-proportioned spring, and it is recommended that springs be so made unless there are good reasons to the contrary. When such is the case, the size of steel is found as follows :—

$$\left.\begin{array}{l} \sqrt{\frac{S}{1600}} = d \\ 1600d^2 = S \end{array}\right\} \text{for round steel.}$$

$$\left.\begin{array}{l} \sqrt{\frac{S}{2200}} = d \\ 2200d^2 = S \end{array}\right\} \text{for square steel.}$$

rings of less strength should not be used for safety valves, as anent set takes place at from 3·25 to 3·5 times the load found by ɔrmulæ.

e compression due to the load, or the number of coils required for ven compression, can be found approximately by what follows. compression varies slightly, owing to differences in the hardness, of the steel; but the formulæ will be found sufficiently accurate for ical purposes.

$$\frac{S \times D^3 \times N}{1400000 \times d^4} = K \text{ (Springs made of round steel).}$$

$$\frac{S \times D^3 \times N}{2000000 \times d^4} = K \text{ (Springs made of square steel.}$$

f d be taken in $\frac{1}{16}$ths, instead of in inches

$$\left.\begin{array}{l} \dfrac{S \times D^3 \times N}{22 \times d^4} = K \\[2ex] \dfrac{K \times 22 \times d^4}{S \times d^3} = N \end{array}\right\} \text{Springs made of round steel.}$$

$$\left.\begin{array}{l} \dfrac{S \times D^3 \times N}{30 \times d^4} = K \\[2ex] \dfrac{K \times 30 \times d^4}{S \times D^3} = N \end{array}\right\} \text{Springs made of square steel.}$$

ıe compression of springs of safety valves should not be less than fourth the diameter of the valve, and it is desirable that it should ıore. It is better for boilers to have common valves and springs good elasticity, than lip valves with rigid springs, as the action ıe latter is often very violent, and causes excessive vibration, h should be avoided if possible.

SPIRAL SPRINGS MADE OF STEEL.

Tested to ascertain Compression, &c., due to different Load applied up to Twice the Working Load.

Shape of Steel.	Size of Steel.	Pitch of Coils.	Mean Diameter of Coils.	Number of Complete Coils.	Original Length of Spring.	Length of Spring with working load on it.	Working Load.	Compression produced by working load.	Compression produced by twice the working load.	Average compression due to each 56 lbs. applied up to the working load.	Average compression due to
	in.	in.	ins.		ins.	ins.	lbs.	ins.	ins.	in.	
Square	$\frac{1}{4}$	$\frac{7}{16}$	$1\frac{1}{4}$	7	$3\frac{1}{4}$	2·98	137	·27	·55	·110	
	$\frac{3}{8}$	$\frac{15}{16}$	$2\frac{1}{2}$	7	$6\frac{5}{16}$	5·85	550	·46	·92	·046	
	$\frac{1}{2}$	$1\frac{9}{32}$	$3\frac{3}{4}$	7	$9\frac{9}{16}$	8·84	1237	·72	1·44	·032	
Square	$\frac{3}{8}$	·648	$1\frac{7}{8}$	$13\frac{1}{2}$	$8\frac{3}{4}$	8·09	309	·66	1·33	·120	
	$\frac{7}{16}$	·759	$2\frac{3}{16}$	$13\frac{1}{2}$	$10\frac{1}{4}$	9·5	421	·75	1·51	·100	
	$\frac{1}{2}$	·870	$2\frac{1}{2}$	$13\frac{1}{2}$	$11\frac{3}{4}$	10·73	550	1·02	2·02	·103	
	$\frac{9}{16}$	·962	$2\frac{13}{16}$	$13\frac{1}{2}$	13	11·94	696	1·06	2·11	·085	
	$\frac{5}{8}$	1·074	$3\frac{1}{8}$	$13\frac{1}{2}$	$14\frac{1}{2}$	13·3	859	1·20	2·40	·078	
	$\frac{11}{16}$	1·185	$3\frac{7}{16}$	$13\frac{1}{2}$	16	14·65	1039	1·35	2·69	·072	
	$\frac{3}{4}$	1·296	$3\frac{3}{4}$	$13\frac{1}{2}$	$17\frac{1}{2}$	16·14	1237	1·36	2·71	·061	
	$\frac{13}{16}$	1·407	$4\frac{1}{16}$	$13\frac{1}{2}$	19	17·56	1452	1·44	2·87	·055	
	$\frac{7}{8}$	1·509	$4\frac{3}{8}$	$13\frac{1}{2}$	$20\frac{3}{8}$	18·73	1684	1·64	3·29	·054	
	$\frac{15}{16}$	1·611	$4\frac{11}{16}$	$13\frac{1}{2}$	$21\frac{3}{4}$	19·99	1933	1·76	3·51	·050	
	1	1·722	5	$13\frac{1}{2}$	$23\frac{1}{4}$	21·42	2200	1·83	3·66	·046	
Round	$\frac{3}{8}$	·648	$1\frac{7}{8}$	$13\frac{1}{2}$	$8\frac{3}{4}$	8·11	225	·64	1·30	·160	
	$\frac{7}{16}$	·759	$2\frac{3}{16}$	$13\frac{1}{2}$	$10\frac{1}{4}$	9·53	306	·72	1·50	·131	
	$\frac{1}{2}$	·870	$2\frac{1}{2}$	$13\frac{1}{2}$	$11\frac{3}{4}$	10·83	400	·92	1·85	·128	
	$\frac{9}{16}$	·962	$2\frac{13}{16}$	$13\frac{1}{2}$	13	11·93	506	1·07	2·10	·118	
	$\frac{5}{8}$	1·074	$3\frac{1}{8}$	$13\frac{1}{2}$	$14\frac{1}{2}$	13·25	625	1·25	2·46	·112	
	$\frac{11}{16}$	1·185	$3\frac{7}{16}$	$13\frac{1}{2}$	16	14·78	756	1·22	2·44	·090	
	$\frac{3}{4}$	1·296	$3\frac{3}{4}$	$13\frac{1}{2}$	$17\frac{1}{2}$	16·18	900	1·32	2·61	·082	
	$\frac{13}{16}$	1·407	$4\frac{1}{16}$	$13\frac{1}{2}$	19	17·47	1056	1·53	2·99	·081	
	$\frac{7}{8}$	1·509	$4\frac{3}{8}$	$13\frac{1}{2}$	$20\frac{3}{8}$	18·69	1225	1·68	3·35	·076	
	$\frac{15}{16}$	1·611	$4\frac{11}{16}$	$13\frac{1}{2}$	$21\frac{3}{4}$	20·02	1406	1·73	3·42	·068	
	1	1·722	5	$13\frac{1}{2}$	$23\frac{1}{4}$	21·37	1600	1·88	3·76	·065	
Square	$\frac{1}{4}$	$\frac{7}{16}$	$1\frac{1}{4}$	21	$9\frac{11}{16}$	8·98	137	·70	1·39	·286	
	$\frac{3}{8}$	$\frac{15}{16}$	$2\frac{1}{2}$	21	$18\frac{1}{2}$	17·32	550	1·55	3·12	·157	
	$\frac{1}{2}$	$1\frac{21}{64}$	$3\frac{3}{4}$	21	$28\frac{1}{4}$	26·23	1237	2·02	3·98	·091	

SPIRAL SPRINGS MADE OF STEEL.

Tested to ascertain Compression, &c., due to different Loads applied until the Springs Closed or Broke.

Shape of Steel.	Size of Steel.	Pitch of Coils.	Mean Diameter of Coils.	Number of complete Coils.	Original Length of Spring.	Length of Spring after Test.	Working Load.	Compression produced by working load.	Load which produced permanent set.	Total compression produced by load which produced permanent set.	Load which produced permanent set divided by the working load.	Average compression due to each 112 lbs. applied before permanent set took place.	Permanent set began at	Distortion began at	Spring much distorted at	Spring closed at
	in	ins.	ins.		ins.	ins.	lbs.	in.	lbs.	ins.		in.	lbs.	lbs.	lbs.	lbs.
Square	$\frac{3}{8}$	$1\frac{5}{32}$	$1\frac{7}{8}$	7	8	$5\frac{29}{32}$	309	·40	938	1·14	3·03	·138	938	1344	1568	1792
Square	$\frac{7}{16}$	$1\frac{5}{16}$	$2\frac{3}{16}$	7	$9\frac{1}{4}$	$6\frac{11}{16}$	421	·41	1750	1·78	4·15	·109	1750	1897	2121	2352
Square	$\frac{1}{2}$	$1\frac{1}{2}$	$2\frac{1}{2}$	7	$10\frac{1}{2}$	$7\frac{1}{2}$	550	·46	2100	1·84	3·81	·097	2100	2744	2856	3192
Square	$\frac{9}{16}$	$1\frac{3}{4}$	$2\frac{13}{16}$	7	12	$8\frac{1}{4}$	696	·60	2772	2·34	3·98	·091	2772	2961	3188	3864
Square	$\frac{5}{8}$	$1\frac{15}{16}$	$3\frac{1}{8}$	7	$13\frac{5}{16}$	$10\frac{1}{2}$	859	·65	2850	2·31	3·31	·089	2850	3814	4154	4480
Square	$\frac{11}{16}$	$2\frac{1}{16}$	$3\frac{7}{16}$	7	$14\frac{5}{8}$	$12\frac{1}{4}$	1039	·66	4440	3·12	4·27	·077	4440	5068	5520	6272
Square	$\frac{3}{4}$	$2\frac{5}{16}$	$3\frac{3}{4}$	7	$16\frac{1}{8}$	Broke	1237	·8	4224	3·03	3·41	·078	4224	5355	Broke at	5600
Round	$\frac{3}{8}$	$1\frac{1}{8}$	$1\frac{7}{8}$	7	8	$5\frac{3}{4}$	225	·34	700	1·05	3·11	·166	700	923	1484	1680
Round	$\frac{7}{16}$	$1\frac{5}{16}$	$2\frac{3}{16}$	7	$9\frac{1}{4}$	$6\frac{11}{16}$	306	·35	1099	1·40	3·59	·140	1099	1512	1610	2072
Round	$\frac{1}{2}$	$1\frac{1}{2}$	$2\frac{1}{2}$	7	$10\frac{1}{2}$	$7\frac{1}{2}$	400	·46	1666	2·0	4·16	·135	1666	2086	2190	2632
Round	$\frac{9}{16}$	$1\frac{3}{4}$	$2\frac{13}{16}$	7	12	$9\frac{5}{16}$	506	·57	1596	1·64	3·15	·113	1596	2317	2667	2912
Round	$\frac{5}{8}$	$1\frac{15}{16}$	$3\frac{1}{8}$	7	$13\frac{5}{16}$	$9\frac{3}{4}$	625	·68	2739	2·93	4·38	·117	2739	3267	3737	4368
Round	$\frac{11}{16}$	$2\frac{1}{8}$	$3\frac{7}{16}$	7	$14\frac{5}{8}$	12	756	·67	3212	3·15	4·24	·109	3212	3818	4026	4480
Round	$\frac{3}{4}$	$2\frac{5}{16}$	$3\frac{3}{4}$	7	$16\frac{1}{8}$	12	900	·77	3626	3·05	4·02	·093	3626	5110	5572	6048

The results of the foregoing six series of experiments fairly represent what may be expected in general practice, and although possibly by theoretical investigation, with refinements of measurements, &c., slight irregularities may be found, the results are of more practical value than if they had been selected, as they might have been, from a number of other series, to make them agree more nearly with theory. Many exactly similar conditions must exist, which are never found in practice, to insure the results from a number of series being exactly alike: for instance, the quality of steel and the temper must be the same, both the steel and springs must have exactly the same dimensions, the ends of springs must be finished in precisely the same way, &c.

Formulæ as to springs will be found in another part of the book, by the use of which results practically in accordance with a number of tests and with practice are obtained.

PROPERTIES OF SATURATED STEAM.

The following Tables, Nos. 218 to 224, giving the temperature, volume, density, cubic feet per lb., and latent heat and total heat of evaporation of one lb. of steam, have been computed at intervals of one lb. per square inch for pressures ranging from 14 lbs. per square inch below atmospheric pressure to 200 lbs. per square inch above the mean atmospheric pressure of 14·7 lbs. per square inch.

PROPERTIES OF SATURATED STEAM.

Pressure per Square Inch from Mean Atmospheric Pressure. lbs.	Temperature in Fahrenheit Degrees.	Specific or Relative Volume of the Steam.	Density or Weight of 1 Cubic Foot of the Steam. lb.	Cubic Feet of the Steam per lb.	Latent Heat of Evaporation in Thermal Units per lb. of the Steam.	Total Heat in Thermal Units from 32° Fahrenheit per lb. of the Steam.	Absolute Pressure per Square Inch. lbs.
−14	90·4	28740	·002170	460·7	1051·1	1109·5	·7
−13	120·8	12480	·004998	200·1	1030·3	1118·6	1·7
−12	137·5	8080	·007720	129·5	1018·4	1123·9	2·7
−11	149·8	6009	·01038	96·32	1009·8	1127·6	3·7
−10	159·7	4799	·01300	76·92	1003·0	1130·7	4·7
−9	167·9	4003	·01558	64·17	997·3	1133·2	5·7
−8	174·9	3439	·01814	55·12	992·4	1135·3	6·7
−7	181·1	3010	·02072	48·25	988·1	1137·2	7·7
−6	186·7	2690	·02319	43·12	984·2	1138·9	8·7
−5	191·8	2428	·02568	38·93	980·6	1140·4	9·7
−4	196·4	2215	·02817	35·50	977·5	1141·9	10·7
−3	200·7	2036	·03063	32·64	974·5	1143·2	11·7
−2	204·7	1886	·03307	30·24	971·7	1144·4	12·7
−1	208·5	1755	·03553	28·14	969·0	1145·5	13·7
Atmosphere.	212·0	1643	·03797	26·34	966·6	1146·6	14·7
1	215·3	1544	·04039	24·76	964·3	1147·6	15·7
2	218·5	1457	·04280	23·36	962·1	1148·6	16·7
3	221·5	1380	·04521	22·12	960·0	1149·5	17·7
4	224·4	1310	·04761	21·0	958·0	1150·4	18·7
5	227·1	1248	·05000	20·0	956·1	1151·2	19·7
6	229·8	1191	·05238	19·09	954·2	1152·0	20·7
7	232·3	1139	·05475	18·26	952·5	1152·8	21·7
8	234·7	1092	·05712	17·51	950·8	1153·5	22·7
9	237·1	1049	·05949	16·81	949·2	1154·3	23·7
10	239·4	1009	·06184	16·17	947·6	1155·0	24·7
11	241·6	971·8	·06419	15·58	946·0	1155·6	25·7
12	243·7	937·5	·06654	15·03	944·6	1156·3	26·7
13	245·8	905·7	·06888	14·52	943·1	1156·9	27·7
14	247·8	876·0	·07122	14·04	941·7	1157·5	28·7
15	249·7	818·2	·07355	13·60	940·4	1158·1	29·7
16	251·6	822·2	·07587	13·18	939·1	1158·7	30·7

PROPERTIES OF SATURATED STEAM.

Pressure per Square Inch from Mean Atmospheric Pressure. lbs.	Temperature in Fahrenheit Degrees.	Specific or Relative Volume of the Steam.	Density or Weight of 1 Cubic Foot of the Steam. lb.	Cubic Feet of the Steam per lb.	Latent Heat of Evaporation in Thermal Units per lb. of the Steam.	Total Heat in Thermal Units from 32° Fahrenheit per lb. of the Steam.	Absolut[e] Pressur[e] per Square Inch. lbs.
17	253·5	797·8	·07819	12·79	937·8	1159·3	31·7
18	255·3	774·9	·08050	12·42	926·5	1159·8	32·7
19	257·0	753·2	·08282	12·07	935·3	1160·3	33·7
20	258·7	732·8	·08513	11·75	934·2	1160·9	34·7
21	260·4	713·5	·08743	11·44	933·0	1161·4	35·7
22	262·0	695·2	·08973	11·14	931·9	1161·9	36·7
23	263·6	677·9	·09203	10·87	930·7	1162·3	37·7
24	265·2	661·4	·09433	10·60	929·6	1162·8	38·7
25	266·7	645·7	·09661	10·35	928·6	1163·3	39·7
26	268·2	630·8	·09890	10·11	927·6	1163·8	40·7
27	269·7	616·6	·1011	9·883	926·5	1164·2	41·7
28	271·1	603·0	·1034	9·666	925·5	1164·6	42·7
29	272·6	590·0	·1057	9·458	924·5	1165·1	43·7
30	273·9	577·6	·1080	9·259	923·6	1165·5	44·7
31	275·3	565·7	·1102	9·068	922·6	1165·9	45·7
32	276·7	554·3	·1125	8·885	921·6	1166·3	46·7
33	278·0	543·4	·1148	8·710	920·7	1166·7	47·
34	279·3	532·9	·1170	8·541	919·8	1167·1	48·
35	280·5	522·8	·1193	8·380	919·0	1167·5	49
36	281·8	513·1	·1215	8·225	918·1	1167·9	50
37	283·0	503·8	·1238	8·075	917·3	1168·3	51
38	284·2	494·8	·1260	7·931	916·4	1168·6	52
39	285·4	486·1	·1283	7·792	915·6	1169·0	5
40	286·6	477·7	·1305	7·658	914·8	1169·4	5
41	287·8	469·7	·1328	7·529	913·9	1169·7	5
42	288·9	461·9	·1350	7·404	913·2	1170·1	5
43	290·1	454·4	·1373	7·283	912·3	1170·4	5
44	291·2	447·1	·1395	7·167	911·6	1170·8	
45	292·3	440·0	·1417	7·054	910·8	1171·1	
46	293·4	433·2	·1440	6·944	910·0	1171·4	
47	294·4	426·6	·1462	6·839	909·3	1171·7	

PROPERTIES OF SATURATED STEAM.

Pressure per Square Inch from Mean Atmospheric Pressure. lbs.	Temperature in Fahrenheit Degrees.	Specific or Relative Volume of the Steam.	Density or Weight of 1 Cubic Foot of the Steam. lb.	Cubic Feet of the Steam per lb.	Latent Heat of Evaporation in Thermal Units per lb. of the Steam.	Total Heat in Thermal Units from 32° Fahrenheit per lb. of the Steam.	Absolute Pressure per Square Inch. lbs.
48	295·5	420·2	·1484	6·736	908·6	1172·1	62·7
49	296·5	414·1	·1506	6·636	907·9	1172·4	63·7
50	297·5	408·0	·1529	6·540	907·2	1172·7	64·7
51	298·6	402·2	·1551	6·446	906·4	1173·0	65·7
52	299·6	396·5	·1573	6·356	905·7	1173·3	66·7
53	300·6	391·0	·1595	6·267	905·0	1173·6	67·7
54	301·5	385·6	·1617	6·181	904·4	1173·9	68·7
55	302·5	380·4	·1639	6·098	903·7	1174·2	69·7
56	303·5	375·4	·1661	6·017	903·0	1174·5	70·7
57	304·4	370·4	·1684	5·938	902·4	1174·8	71·7
58	305·3	365·6	·1706	5·861	901·8	1175·1	72·7
59	306·3	361·0	·1728	5·786	901·1	1175·4	73·7
60	307·2	356·4	·1750	5·714	900·4	1175·6	74·7
61	308·1	352·0	·1772	5·643	899·8	1175·9	75·7
62	309·0	347·7	·1794	5·573	899·2	1176·2	76·7
63	309·9	343·5	·1816	5·506	898·6	1176·5	77·7
64	310·8	339·4	·1838	5·440	897·9	1176·7	78·7
65	311·6	335·4	·1860	5·376	897·4	1177·0	79·7
66	312·5	331·5	·1882	5·313	896·8	1177·3	80·7
67	313·3	327·7	·1904	5·252	896·2	1177·5	81·7
68	314·2	323·9	·1926	5·192	895·6	1177·8	82·7
69	315·0	320·3	·1947	5·134	895·0	1178·0	83·7
70	315·8	316·7	·1969	5·077	894·5	1178·3	84·7
71	316·7	313·3	·1991	5·021	893·8	1178·5	85·7
72	317·5	309·9	·2013	4·967	893·3	1178·8	86·7
73	318·3	306·5	·2035	4·914	892·7	1179·0	87·7
74	319·1	303·3	·2056	4·862	892·2	1179·3	88·7
75	319·9	300·1	·2078	4·811	891·6	1179·5	89·7
76	320·7	297·0	·2100	4·761	891·1	1179·8	90·7
77	321·4	294·0	·2122	4·712	890·6	1180·0	91·7
78	322·2	291·0	·2144	4·664	890·0	1180·2	92·7

PROPERTIES OF SATURATED STEAM.

Pressure per Square Inch from Mean Atmospheric Pressure. lbs.	Temperature in Fahrenheit Degrees.	Specific or Relative Volume of the Steam.	Density or Weight of 1 Cubic Foot of the Steam. lb.	Cubic Feet of the Steam per lb.	Latent Heat of Evaporation in Thermal Units per lb. of the Steam.	Total H in The mal Un from 3 Fahrenh per lb. the Stea
79	323·0	288·0	·2165	4·617	889·5	1180·
80	323·8	285·2	·2187	4·572	888·9	1180·
81	324·5	282·4	·2209	4·527	888·4	1180·
82	325·2	279·6	·2230	4·483	887·9	1181·
83	326·0	276·9	·2252	4·439	887·4	1181·
84	326·7	274·3	·2274	4·397	886·9	1181·
85	327·4	271·7	·2295	4·356	886·4	1181·
86	328·1	269·2	·2317	4·315	885·9	1182·
87	328·9	266·7	·2339	4·275	885·4	1182·
88	329·6	264·3	·2360	4·236	884·9	1182·
89	330·3	261·9	·2382	4·198	884·4	1182·
90	331·0	259·5	·2404	4·160	883·9	1182·
91	331·7	257·2	·2425	4·123	883·4	1183·
92	332·3	254·9	·2447	4·087	883·0	1183·
93	333·0	252·5	·2468	4·051	882·5	1183·
94	333·7	250·5	·2490	4·016	882·0	1183·
95	334·4	248·4	·2511	3·981	881·5	1183·
96	335·1	246·3	·2533	3·948	881·1	1184·
97	335·7	244·2	·2554	3·914	880·6	1184·
98	336·4	242·2	·2576	3·882	880·2	1184·
99	337·0	240·1	·2598	3·849	879·7	1184·
100	337·7	238·2	·2619	3·818	879·2	1184·
101	338·3	236·2	·2640	3·787	878·8	1185·
102	339·0	234·3	·2662	3·757	878·3	1185·
103	339·6	232·5	·2683	3·727	877·9	1185·
104	340·2	230·6	·2704	3·697	877·5	1185·
105	340·9	228·8	·2726	3·668	877·0	1185·
106	341·5	227·0	·2747	3·639	876·6	1186·
107	342·1	225·1	·2769	3·611	876·2	1186·
108	*342·7*	223·6	·2790	3·584	875·8	1186·
109	*343·3*	221·9	·2811	3·556	875·4	1186·

PROPERTIES OF SATURATED STEAM.

Pressure per Square Inch from Mean Atmospheric Pressure. lbs.	Temperature in Fahrenheit Degrees.	Specific or Relative Volume of the Steam.	Density or Weight of 1 Cubic Foot of the Steam. lb.	Cubic Feet of the Steam per lb.	Latent Heat of Evaporation in Thermal Units per lb. of the Steam.	Total Heat in Thermal Units from 32° Fahrenheit per lb. of the Steam.	Absolute Pressure per Square Inch. lbs.
110	343·9	220·1	·2833	3·530	874·9	1186·8	124·7
111	344·5	218·5	·2854	3·503	874·5	1187·0	125·7
112	345·1	216·9	·2875	3·477	874·1	1187·2	126·7
113	345·7	215·3	·2897	3·452	873·7	1187·4	127·7
114	346·3	213·7	·2918	3·426	873·3	1187·6	128·7
115	346·9	212·2	·2939	3·401	872·9	1187·8	129·7
116	347·5	210·7	·2961	3·377	872·4	1187·9	130·7
117	348·1	209·2	·2982	3·353	872·0	1188·1	131·7
118	348·7	207·7	·3003	3·329	871·6	1188·3	132·7
119	349·2	206·2	·3025	3·306	871·3	1188·5	133·7
120	349·8	204·8	·3046	3·283	870·8	1188·6	134·7
121	350·4	203·4	·3067	3·260	870·4	1188·8	135·7
122	351·0	202·0	·3088	3·237	870·0	1189·0	136·7
123	351·5	200·6	·3110	3·215	869·7	1189·2	137·7
124	352·1	199·2	·3131	3·194	869·2	1189·3	138·7
125	352·6	197·9	·3152	3·172	868·9	1189·5	139·7
126	353·2	196·6	·3173	3·151	868·5	1189·7	140·7
127	353·7	195·3	·3194	3·130	868·1	1189·8	141·7
128	354·3	194·0	·3216	3·109	867·7	1190·0	142·7
129	354·8	192·7	·3237	3·089	867·4	1190·2	143·7
130	355·4	191·5	·3258	3·069	866·9	1190·3	144·7
131	355·9	190·2	·3279	3·049	866·6	1190·5	145·7
132	356·4	189·0	·3300	3·030	866·3	1190·7	146·7
133	357·0	187·8	·3321	3·010	365·8	1190·8	147·7
134	357·5	186·6	·3343	2·991	865·5	1191·0	148·7
135	358·0	185·4	·3364	2·973	865·1	1191·1	149·7
136	358·5	184·3	·3385	2·954	864·8	1191·3	150·7
137	359·1	182·9	·3406	2·936	864·4	1191·5	151·7
138	359·6	182·0	·3427	2·918	864·0	1191·6	152·7
139	360·1	180·9	·3448	2·900	863·7	1191·8	153·7
140	360·6	179·8	·3469	2·882	863·3	1191·9	154·7

PROPERTIES OF SATURATED STEAM.

Pressure per Square Inch from Mean Atmospheric Pressure. lbs.	Temperature in Fahrenheit Degrees.	Specific or Relative Volume of the Steam.	Density or Weight of 1 Cubic Foot of the Steam. lb.	Cubic Feet of the Steam per lb.	Latent Heat of Evaporation in Thermal Units per lb. of the Steam.	Total Heat in Thermal Units from 32° Fahrenheit per lb. of the Steam
141	361·1	178·7	·3490	2·865	863·0	1192·1
142	361·6	177·6	·3511	2·848	862·6	1192·2
143	362·1	176·6	·3532	2·831	862·3	1192·4
144	362·6	175·5	·3554	2·814	861·9	1192·5
145	363·1	174·5	·3575	2·797	861·6	1192·7
146	363·6	173·5	·3596	2·781	861·2	1192·8
147	364·1	172·5	·3617	2·765	860·9	1193·0
148	364·6	171·5	·3638	2·749	860·6	1193·2
149	365·1	170·5	·3659	2·733	860·2	1193·3
150	365·6	169·5	·3680	2·717	859·9	1193·5
151	366·1	168·6	·3701	2·702	859·5	1193·6
152	366·6	167·6	·3722	2·687	859·2	1193·8
153	367·1	166·7	·3743	2·672	858·8	1193·9
154	367·5	165·7	·3764	2·657	858·5	1194·0
155	368·0	164·8	·3785	2·642	858·2	1194·2
156	368·5	163·9	·3806	2·627	857·8	1194·3
157	369·0	163·0	·3827	2·613	857·5	1194·5
158	369·4	162·1	·3847	2·599	857·2	1194·6
159	369·9	161·2	·3868	2·585	856·9	1194·8
160	370·4	160·4	·3889	2·571	856·5	1194·9
161	370·8	159·5	·3910	2·557	856·2	1195·0
162	371·3	158·7	·3931	2·543	855·9	1195·2
163	371·7	157·8	·3952	2·530	855·6	1195·3
164	372·2	157·0	·3973	2·517	855·3	1195·5
165	372·7	156·2	·3994	2·504	854·9	1195·6
166	373·1	155·4	·4015	2·491	854·6	1195·7
167	373·6	154·6	·4036	2·478	854·3	1195·9
168	374·0	153·8	·4057	2·465	854·0	1196·0
169	374·5	153·0	·4077	2·452	853·7	1196·2
170	374·9	152·2	·4098	2·440	853·4	1196·3
171	375·4	151·4	·4119	2·427	853·0	1196·4

PROPERTIE[S] [illegible]

Pressure per Square Inch from Mean Atmospheric Pressure.	Temperature Fahrenheit Degrees.	[illegible]	[illegible]	[illegible]
lbs.			[illegible]	
17[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
17[illegible]	[illegible]	[illegible]	[illegible]	2·40[illegible]
17[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
17[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
17[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
17[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
17[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
17[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
18[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
18[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
18[illegible]	[illegible]	[illegible]	·43[illegible]	2·30[illegible]
18[illegible]	[illegible]	[illegible]	·486	2·[illegible]
18[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
18[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
18[illegible]	[illegible]	[illegible]	[illegible]	2·[illegible]
18[illegible]	[illegible]	[illegible]	[illegible]	2·24[illegible]
18[illegible]	[illegible]	[illegible]	[illegible]	2·2[illegible]
1[illegible]	35[illegible]	[illegible]	·449	2·225
1[illegible]	35[illegible]	[illegible]	[illegible]	2·215
1[illegible]	35[illegible]	[illegible]	[illegible]	2·205
1[illegible]	35[illegible]	[illegible]	[illegible]	2·1[illegible]
1[illegible]	[illegible]	[illegible]	[illegible]	2·1[illegible]
1[illegible]	[illegible]	[illegible]	·45[illegible]	2·175
1[illegible]	[illegible]	[illegible]	·4[illegible]	2·1[illegible]
1[illegible]	[illegible]	[illegible]	·45[illegible]	2·15[illegible]
1[illegible]	[illegible]	13[illegible]	·465	2·1[illegible]
1[illegible]	[illegible]	13[illegible]	·466	2·137
1[illegible]	[illegible]	13[illegible]	[illegible]	2·127
20[illegible]	[illegible]	13[illegible]	[illegible]	2·118

INDEX.

PRINTED BY NEILL AND COMPANY, EDINBURGH.